

Daily mutual fund net asset value predictability and the associated trading profit opportunity

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Daily mutual fund net asset value predictability and the associated trading profit opportunity

Daily changes in mutual fund net asset values (NAVs) are both serially correlated and predicted by prior-day movements in market indices. The major source of NAV predictability is fund companies using stale prices for non-trading assets in calculating NAVs. Stale prices, and thus NAV predictability, are most common for less liquid or more volatile assets and for international assets that trade in different time zones. Investors in international equity, U.S. small-cap equity, and high-yield bond funds can exploit this phenomenon and earn abnormal returns of 9-12 percent, 6-8 percent, and 2-4 percent, respectively, while making only four roundtrip trades per year. Although many funds charge loads or short-term transaction fees that would reduce or eliminate the profitability of such a strategy, a survey of the seven largest no-load mutual fund companies found that 40 out of 83 funds with profit opportunities greater than 4 percent had no such fees. If investors can avoid these trading frequency restrictions, e.g. by moving money between fund families, they can earn excess returns of roughly 36, 18, and 10 percent in these three types of funds.

It is well known that non-synchronous trading generates serial correlation in daily portfolio returns.¹ This is not generally regarded as a violation of market efficiency, since if one tried to buy a portfolio containing securities with stale prices after the market had risen, one would likely find the holders of the securities demanding more than the stale prices, eliminating the profit opportunity.² The difference with mutual funds is that the funds com-

mit themselves to buy or sell their funds' portfolio at whatever NAV they calculate.³ In principle, fund companies could adjust the pricing of non-trading securities to reflect market movements and thus eliminate any NAV predictability; most funds reserve the right to do so in their prospectuses.⁴ In practice, funds adjust last-trade equity prices very rarely, although they do use third-party pricing services to calculate the value of non-trading bonds. The analysis in the first section suggests that any adjustments made to equity-fund NAVs remove only 0-20 percent of predictability and that the adjustments made to high-yield bond prices actually exacerbates the predictability of NAVs.

The potential to profitability trade mutual funds based on NAV predictability has been mentioned in a few recent papers.⁵ This paper makes two main contributions to this literature. First, it documents NAV predictability much more comprehensively than has been done before, examining all asset classes and using data that include 95 percent of funds in the Morningstar universe. NAV predictability is most pronounced in international funds, the focus of other studies, but large profit opportunities also exist in U.S. small cap equity, high-yield bonds, and specialty equity funds (e.g., energy, precious metals, and real estate). NAV predictability is not a recent phenomenon; it is present to roughly the same extent in data back to 1986. This paper uses a refined trading rule that yields higher estimates of trading strategy profitability than in previous studies,⁶ suggesting a more urgent need for changes in mutual fund policies. It also examines cross-sectional differences in trading profitability across funds, producing

results that are both consistent with stale prices being the primary cause of NAV predictability and potentially helpful in the *ex-ante* selection of funds likely to exhibit predictability. Any reader who dismissed earlier findings about NAV predictability as an economically insignificant profit opportunity, as a data mining result with insufficient evidence about the source of the anomaly, or as coming from a small sample of funds, a short time series, or a single asset class should reconsider their position.

Second, this paper provides insights useful to fund companies or regulatory authorities interested in reducing the threat to buy-and-hold investors. An analysis of short-term trading fees that are currently used by some funds to limit trading profit opportunities reveals that the fees are neither large nor universal enough to protect buy-and-hold investors. Given that eliminating the trading profit opportunity through fees alone would require short-term trading fees of about three percent in no-load international funds, a level that is not likely to be readily accepted by investors, reducing NAV predictability by updating stale prices is an attractive alternative, but not without its difficulties. An obvious methodology of using ADRs or U.S.-traded World Equity Benchmark Shares (WEBS) to update prices is problematic since evidence in this paper reveals that returns in these securities are predictable in the same way that fund NAVs are. Furthermore, the evidence that the price updating currently done for high-yield bond funds actually exacerbates return autocorrelation and increases overall predictability suggests that price updating methodologies need to be scrutinized carefully.

The remainder of the paper is organized in five sections. The first section

documents the predictability of daily NAV changes by lagged NAV and S&P 500 changes and compares the predictability of fund NAVs with unadjusted portfolios of similar assets, finding that any adjustments to equity closing prices remove only 0-20 percent of predictability and that the adjustments made to high-yield bond prices exacerbate predictability. The second section estimates the excess returns from trading based on the predictability of NAVs. The third section examines the cross-sectional variation in fund holdings and characteristics and trading strategy profitability, finding that investors can improve on the excess returns for a fund category by choosing smaller, higher-turnover funds that are more focused on emerging markets, assets traded in other time zones, small-cap growth equities or low-rated, long-maturity bonds. The fourth section finds that returns in exchange-traded closed-end mutual funds, WEBS, and ADRs are predictable in the same manner as open-end fund NAVs, suggesting a lack of awareness of the phenomena discussed in this paper by the primarily non-institutional investors in these relatively illiquid instruments. Index-linked securities that are liquid and primarily institutionally traded, such as index futures and spiders, do not exhibit predictable returns. The fifth section examines the short-term trading fees imposed by no-load funds, finding that their imposition has been non-uniform across fund families and only partly related to the size of the trading profit opportunity. The final section recommends that funds update last-trade equity prices (and revise the bond price updating formulas) to reduce NAV predictability and discusses some of the legal and institutional issues involved.

I Predictability of daily NAV changes

This section documents the predictability of daily net asset value changes. The first subsection discusses the data used in this paper. The second and third document NAV predictability due to serial correlation, predictability by prior-day market index changes, and day-of-the-week effects. The fourth subsection estimates a predictive model on which a trading strategy could be based.

I.A Data

The data on daily net asset values of mutual funds were downloaded from *quote.yahoo.com*; the original source of the data is Commodity Systems, Inc. Data was available for 8,763 of the 9,220 funds in the Morningstar universe that had ticker symbols.⁷ Since data before 1996 was only sparsely available, the main sample was restricted to the years 1996-99. An average of 698 days (2.9 years) of data was available for each fund.⁸ Cross-sectional data on the mutual funds were taken from the October 1999 Morningstar CD-ROM; the median date of the fund composition data on this CD was June 1999. Data on market indices were downloaded from *quote.yahoo.com* and from the Morgan Stanley Capital International web site (*msci.com*).

The daily return data required some cleaning. Out of 6.1 million daily return observations, 228 with absolute values greater than 30 log percentage points were removed. Of these, 23 were due to NAV changes by a factor of either 10 or 100, and 44 were changes that were reversed within 2 days

and thus likely to be data entry errors. Eighty percent of the remaining 161 large changes were negative and fifty percent were in December, so they are probably mostly due to non-inclusion of dividend and capital-gain distributions. Some dividend data was available in the *quote.yahoo.com* data,⁹ but it was recorded with payment dates rather than recording dates, which is when dividend and capital gain distributions are reflected in net asset values.¹⁰

Non-inclusion of distributions is a problem with the data but not an overly serious one.¹¹ The profitability of a trading strategy will be calculated in a way that makes it independent of the overall level of returns in the given fund; it will be measured as the excess returns to the strategy over the returns to holding the fund and cash in proportion to the number of days the fund was held under the strategy. The main result of dividend non-inclusion is the introduction of noise into 0.5-1.0 percent of the daily NAV observations. This noise reduces the efficiency of estimation and forces us to use heteroskedasticity-robust standard errors. It also biases serial correlation coefficient estimates downward and towards zero and could bias other the coefficients on other predictive variables if they were correlated with dividend distribution (e.g., the coefficient on prior-day market indices if dividends were usually declared following days the market rose). Given the removal of observations with large changes, however, the expected size of these biases is not large.¹² Furthermore, correcting the biases would strengthen the main conclusions that fund returns are serially correlated and positively correlated with prior-day market indices.

I.B Serial correlation and correlation with prior-day market indices

Table I contains estimates of serial correlation and the degree to which returns are predicted by the prior-day change in the S&P 500. For U.S. equities, portfolios of the 8,849 CRSP stocks separated into market capitalization deciles are compared with U.S. equity mutual funds holding stocks with median market capitalizations falling in the same decile. For international equities, international funds are compared with the MSCI index for the region they cover. For bonds, corporate investment-grade and high-yield bond funds are compared with portfolios of bonds with prices available in Datastream that are weighted to have the same average maturity and mixture of credit ratings as the bond funds. The results suggest that: 1) S&P predictability is present to the same degree in international and U.S. small-cap equity funds as in unadjusted equity portfolios,¹³ 2) international and U.S. small-cap equity funds have roughly 100 and 70 percent of the serial correlation of unadjusted portfolios, respectively, 3) S&P predictability is present for unadjusted bond portfolios but not bond funds, and 4) serial correlation is lower for investment-grade bond funds but significantly higher for high-yield. The first two results are consistent with very limited adjustments being made to last-trade equity prices when calculating NAVs; the second two results are consistent with adjustments being made to bond prices that in the case of high-yield bonds actually exacerbate predictability.¹⁴

Table II contains 1-day and 2-day serial correlation and prior-day S&P correlation for nine broad groupings of the 48 Morningstar fund classifica-

tions (the results for all 48 classifications are in Table A1). Several differences between the equity and bonds funds are apparent. First, daily returns are 4-5 times as volatile for equity funds as they are for bond funds. Second, the prior-day S&P 500 change performs much better as a predictor of equity-fund returns than of bond-fund returns. Adding other market indices such as the 10-year Treasury yield to the predictive model has a greater proportionate impact for bond funds. Third, the 2-day lagged NAV changes are not useful predictors for the equity funds but are useful for high-yield and municipal bond funds, suggesting that assets in these funds may go untraded for multiple days.

Within the equity funds, small-cap fund NAV changes are much more predictable than for large-cap funds, and international funds are more predictable still. Within bond funds, high-yield and municipal bond fund NAV changes are much more predictable than for Treasury or investment-grade corporate bonds. The null hypothesis that large-cap equity fund NAV changes are not predictable is not rejected in any of the three regressions, while it is strongly rejected for other equity funds and high-yield and municipal bond funds.

I.C Day-of-the-week effects

Another source of predictability in portfolio returns is the weekend effect, some of which can be attributed to the tendency of closing prices to be ask prices on Friday and bid prices on Monday (Keim and Stambaugh, 1984). Almost all large fund families claim in their prospectuses to use an

average of bid and ask prices to calculate their NAVs, so it is interesting to test whether day-of-the-week effects are any smaller in fund NAVs than in unadjusted portfolios. Table III reports estimated day-of-the-week effects for CRSP deciles and equity funds with comparable median market caps. Both funds and CRSP portfolios have higher returns on Tuesday, Wednesday, and Friday than on Monday and Thursday; this is slightly more true of large-cap than small-cap funds.¹⁵ Day-of-the-week effects are at least as large in fund NAVs as in unadjusted CRSP portfolios, suggesting that little correction is made for bid-ask bounce as claimed in fund prospectuses.

Other sources of return predictability, such as the January effect, may also be helpful in predicting fund returns, but these will not be investigated in this paper given that the concentration of the data in 1997-99 reduces the power for estimating month or other annual effects.

I.D A predictive model

This section estimates and examines the power of a predictive model based on the phenomena discussed above. Table IV contains the results from regressions modeling NAV changes as a function of 2-day lagged own-fund NAV changes, 2-day lagged category-average NAV changes, and 1-day lagged changes in market indices.¹⁶ Two-day lagged NAV changes are used since fund purchasing decisions typically need to be made before current-day NAVs are known. The market indices are chosen to have a limited amount of overlap and multi-colinearity. The indices included are the S&P 500, Russell 2000, the 10-year Treasury yield, and the all-country MSCI Europe,

Asia-Pacific ex. Japan, Japan, and Latin America indices for free capital markets.

We learn four things from Table IV. First, consistent with the results in Table II, international and small-cap equity and high-yield and municipal bond funds have the most predictable returns. Second, although funds exhibit serial correlation, once category-average changes and market indices are controlled for, the own-fund NAV changes provide little additional predictive power. Third, category-average NAV changes are useful predictors for high-yield and municipal bond funds, perhaps because an index targeted to those assets is not used in the model. Fourth, the U.S. equity indices are the more useful predictors for equity and high-yield funds than for other bond funds, while the 10-year yield is more useful for bond funds than equity funds.

The predictive power of the model in Table IV can be improved for specialty equity funds by including U.S. market indices that are relevant for these funds. Table V compares the predictive power of models including and not including category-specific indices for natural resource, precious metals, and real estate funds. In all cases, including a category-specific index in the model increases predictability and reduces or eliminates the predictive role of the general equity index; this is especially true of the international funds. This suggests that in a trading strategy, switching to specialty funds may be an alternative to cash on days that the general market is declining but the category-specific index is up. In the trading strategy profitability calculations below the possibility of switching to specialty equity funds will

be ignored, but it should be remember that these funds may provide a means for improving on the already quite high profitability estimates calculated in this paper.

The predictive power of the model can also be improved using intra-day changes in the S&P 500. Chalmers et. al. (1999) report that change in the S&P 500 after 2:00 PM has more predictive power than the close-to-close change for U.S. small-cap equity funds. I confirm this finding and also find that S&P 500 change after 11:30 AM (when European markets close) has more predictive power for European funds and the 10:00 AM - 4:00 PM S&P 500 change has more predictive power for Asian funds than the overnight change.¹⁷ This is all consistent with the source of predictability being stale prices, since S&P 500 changes after European and Asian markets close are not reflected in closing prices for stocks traded only on foreign exchanges, and S&P 500 changes after 2:00 PM are less likely to be reflected in the last-trade prices of infrequently trading small-cap stocks.

In contrast, adding day-of-the-week effects to the model increases predictive power only slightly (Table A3). The main effect is for large-cap U.S. equities, for which lagged market indices have relatively little predictive power. The next section examines the profitability of trading using models like the one in Table IV.

II Profitability of a trading strategy

A trading strategy designed to take advantage of the predictability of fund returns would involve buying when expected future returns are high and selling when they are low. In practice this would involve checking the market at 3:55 PM each day and switching between the fund and cash depending on whether expected next-day returns are high or low.¹⁸ In this section, the profitability of such a trading strategy is defined as the expected excess return from shifting between a fund and cash less the return from holding the fund and cash in proportion to the number of days they were held under the strategy. The main advantage of this approach is that the estimate of excess returns does not depend on the average return to the fund in the period studied. As is shown below, four years of data is sufficient to conclude that trading international funds based on NAV predictability outperforms a buy-and-hold strategy. Four years of data is not sufficient, however, to conclude whether holding international mutual funds has positive or negative excess returns relative to cash in a CAPM or multi-factor model, and so we choose a measure of profitability that is feasible given the time spanned by the data.

This measure of trading strategy profitability is most appropriate for individual investors who are substituting the trading strategy for funds and cash that they would otherwise hold as part of an optimal portfolio. Institutional investors who are financing the strategy by borrowing at the risk-free rate would evaluate the strategy based on the expected excess returns relative to a CAPM or multi-factor model, i.e. the alpha, of the strategy. This

can be obtained by adding the excess returns estimated in this section to half the expected alpha of the underlying fund. Morningstar calculates alphas of -1.3, -0.8, and -0.8 for international equity, U.S. small-cap equity, and high-yield bond funds, respectively over the lives of the funds.¹⁹ An alternative approach would be to assume that the expected excess returns on all of the funds holdings are zero and that the expected alpha of the fund is the expense ratio plus the turnover rate times the trading costs; this yields expected alphas of -2.5, -2.2, and -2.1 for international equity, U.S. small-cap equity, and high-yield bond funds, respectively.²⁰ In any case, the adjustments of 0.4-1.2 percent are small relative to the excess returns calculated below.

If we assume that predicted fund returns are normally distributed and serially uncorrelated, a simple and intuitive formula for the profitability of the trading strategy can be derived. This section derives the formula, uses it to estimate trading strategy profitability both in and out of sample, and then compares these estimates with the results from simulations of the strategy for 1998 and 1999. We find that the formula is a close enough approximation to simulated profitability to merit discussion.

II.A Trading strategy returns assuming normal and serially uncorrelated predicted returns

Assuming predicted returns are serially uncorrelated, the excess returns to a trading strategy as defined above can be written as:

$$E(\pi) = \underbrace{N \cdot (E[dP \mid E(dP) > T_+] - E[dP \mid E(dP) < T_-])}_{\text{Number of roundtrip trades times the expected gain}}$$

from buying and selling vis-a-vis the buy-and-hold strategy

where N is the number of round-trip trades per year, dP is the daily fund return less its mean, and T_+ and T_- are the buy and sell triggers in the trading strategy. The triggers are set to achieve a given number (N) of roundtrip trades per year. If normalized predicted fund returns are distributed with c.d.f. $\Phi()$ and p.d.f $\phi()$, they are given by:

$$\begin{aligned} T_+ &= \sigma_{pred} \cdot \Phi^{-1}(1 - \frac{2N}{253}) \\ T_- &= \sigma_{pred} \cdot \Phi^{-1}(\frac{2N}{253}) \end{aligned}$$

If the distribution of expected returns is normal, substituting these triggers into the expression above and evaluating yields:

$$E(\pi) = \underbrace{253 \cdot \phi[\Phi^{-1}(\frac{2N}{253})]}_{\text{Profit factor}} \cdot \underbrace{r \cdot \sigma_{fund}}_{\sigma_{pred}}$$

where σ_{fund} and σ_{pred} are the standard deviations of fund returns and predicted NAV changes, and r is the correlation of predicted and actual fund returns. The profitability of the trading strategy is thus a simple function of the number of roundtrip trades per year (N), the degree to which fund returns are predictable (r), and the volatility of fund returns (σ_{fund}). For

$N = 4$, the trading strategy probability is about 18 times σ_{pred} (see Figure 1 for a graph of the profit factor function).

II.B Actual trading strategy profitability

The formula above assumes that predicted NAV changes are normally distributed and serially uncorrelated. Distributions of financial market movements in fact tend to have fatter tails than the normal distribution, which implies that the above expression may be an underestimate of trading strategy profitability. Likewise, the previous section suggests that predicted NAV changes might be positively serially correlated, which implies that buy and sell decisions would be followed by an upward and downward drift of NAVs, again suggesting that the formula above would be an underestimate. Empirically, however, the formula does fairly well.

Table VI contains estimates of the trading strategy profitability for the nine broad fund categories (see Table A4 for all 48 Morningstar classifications) based on the regression model estimated in Table IV.²¹ Profitability is estimated three ways. First, using the formula derived above. Second, by measuring the difference between the returns on the days following buy and sell triggers. This is done using one and six-day windows. Third, by simulating the profitability of the strategy for 1998 and 1999 by assuming that the investor began in cash, bought at each buy trigger, and held until the next sell trigger. These simulated returns are calculated both in absolute terms and as the residuals from CAPM and multi-factor models.²² The first method is estimated both in and out of sample, while the second

two are calculated out of sample. For the second two methods, the buy and sell triggers are determined by estimating the model in Table IV using only pre-98 data and setting the triggers to achieve four round-trip trades per year using the pre-98 distribution of predicted returns.²³

The different methodologies have different advantages. The one-day window version of methodology 2 yields the most precise estimates, but at the cost of ignoring the drift in returns after buy and sell triggers. For high-yield and municipal bonds, which had high two-day lag autocorrelation (Table II), this drift is substantial. In general, the one-day window version of methodology 2 yields estimates in accord with those estimated using the formula, whereas the other methodologies yield higher but noisier estimates.

The highest returns from the trading strategy are offered by international equity funds, followed by U.S. small and medium-cap equity funds. High-yield and municipal bond funds offer lower returns despite their high return predictability (Table III) due to their lower volatility. Within international funds, emerging market funds offer slightly higher returns than Europe and Japan funds due to both higher predictability (Table A2) and higher volatility (Table A1). Within small and mid-cap U.S. equity funds, the formula and one-day window method suggests that growth funds offer higher returns mainly due to higher volatility, but this result does not appear in the calculations with longer windows.

II.C Reconciliation with Chalmers, et. al. (1999)

The excess returns of 9-12 percent calculated for international funds is almost an order of magnitude higher than the headline figure of 1.2 percent excess returns from short-term trading U.S. equity funds reported by Chalmers, et. al. (1999). Given the magnitude of the difference, it is important to understand the reasons for the differences in the two results.

The source of the differences in the results are summarized in Table VII. The first row contains the Chalmers, et. al. results for all equity funds and all international (equity and bond) funds. They estimate the profitability of a trading strategy based only on past movements in the S&P 500 by taking the difference between fund returns following top and bottom quartile S&P 500 return days. The second row contains my attempt to replicate their results using the same time period (2/98-7/99) but my sample of funds (which includes 8,763 funds instead of 929). My results are close although I find higher profitability for international funds; this profitability figure increases when the international bond funds are dropped. Expanding the time period to 1998-99, the time period I use to estimate out-of-sample trading strategy profitability, has little effect on the results.²⁴

The major differences affecting the results are in the last three rows. First, Chalmers et. al. estimate the profitability of a four roundtrip per year strategy using an extremely conservative method; they compare returns following days in which S&P returns are in the top and bottom *quartiles*. An investor who only wanted to make four roundtrips per year should instead wait until expected returns are in the top 3%; doing so almost doubles

expected profit per trade assuming a normal distribution (although in this sample the effect is a little less than that). Second, Chalmers et. al. condition their strategy only on the S&P 500; as discussed above this ignores useful information in other indices, e.g. the Russell 2000 for U.S. small-cap equities and international indices for emerging market funds. Third, estimating profitability using next-day returns ignores the drift in returns that follows buy and sell triggers.

The difference between the 1.2 and 9-12 percent excess return estimates can therefore be summarized as follows. First, Chalmers et. al. choose to highlight the 1.2 percent returns they calculate for U.S. equities rather than the 2.5 percent they calculate for international funds. This 2.5 percent return increases to 4.2 percent if the sample is expanded to include more funds and days and if international bond funds are excluded. It further increases to 8.3 percent if a more selective trading rule is used, to 8.6 percent if other indices are used, and to (an albeit more noisy estimate of) 11.8 percent if drift is allowed for.

II.D Stability of results over time

The fact that the returns from trading international funds seem to be so high might lead one to wonder whether this is due to the fact that volatility or serial correlation for international equities was especially high in 1996-99. Table A5 examines how σ_{pred} from a model using only the prior-day S&P 500 change has changed from 1986-99.²⁵ Comparing the 1996-99 average with the unweighted 1986-99 gives an indication of how representative the

1996-99 period was. For international and emerging market equity funds, σ_{pred} is about 20 percent lower for the entire 1986-99 period, mainly due to lower volatility. For U.S. small-cap equity funds, however, σ_{pred} is about 10 percent higher for the full period.²⁶ We therefore can conclude that although the 1996-99 period had slightly higher than average volatility for international funds, the conclusions of this paper are true to nearly the same extent in earlier periods as well.

III Cross-sectional variation in fund return predictability

The differences in return predictability and trading strategy profitability across Morningstar classifications suggest that funds dealing in less liquid assets and assets traded in different time zones have more predictable returns. This section examines whether these conclusions are supported by cross-sectional evidence across funds and whether other variables correlated with trading strategy profitability can be found. The results can be used to both further understand the phenomenon of fund return predictability and to identify funds likely to have high trading strategy profitability using information available *ex ante*.

The framework for this section will be to use $\ln(\sigma_{pred})$ and its additive components $\ln(r)$ and $\ln(\sigma_{fund})$ as dependent variables in linear regressions on fund characteristics. This framework has the advantage of making it easy to decompose the relationship of a fund characteristic and trading strategy

profitability into its relationship with predictability and volatility.²⁷

III.A Independent variables

Potential determinants of predictability and trading strategy profitability can be divided into characteristics of the assets the fund holds and characteristics of the fund and how it is managed. For equity funds, the Morningstar data includes information on the share of holdings according to regional, sectoral, and developed/emerging market status, along with median market capitalization and variables to identify stocks as growth or value (price-earnings, price-book, price-cash flow ratios and analysts' expected earnings growth). For bond funds, the share of holdings by S&P rating is available, along with data on average coupon, duration, and the share from government issuers.

Fund characteristics available include the fund family, the age of the fund, the total assets and number of holdings of the fund, the rate of turnover of its assets, the expense ratio, the loads,²⁸ and any purchase restrictions. To the extent that predictability is due to funds not investing extra effort in updating the prices from the most recent trade, one might expect this to be less of a problem for funds at larger families, older funds, larger funds, and funds with either fewer holdings or more assets per holding. One might also expect it to be less of an issue for funds with high turnover, since these funds may limit themselves to more liquid assets. One might further expect that closed funds and those with loads and high expense ratios might either invest in less liquid assets or be less concerned with correcting their

NAVs and thus exhibit more predictability, while funds that are limited to institutional investors might be expected to be particularly concerned with correcting their NAVs and thus have less predictability.

Summary statistics for the dependent and independent variables are given in Table VIII. Out of 8,763 funds with some NAV data, only about 5,000 funds had at least one year of data to estimate predictability and Morningstar data on both holdings and characteristics, but these 5,000 accounted for about 80 percent of total assets under management.

III.B Results

Tables IX and X present the regression results for equity and bond funds, respectively. Results are given for each of the three dependent variables for models without and with fund category fixed effects. By construction, the coefficients for $\ln(r)$ and $\ln(\sigma_{fund})$ add to that for $\ln(\sigma_{pred})$. Fund holdings explain about 70 percent of the variance in predictability and trading strategy profitability for equity funds and about 30-40 percent for bond funds. Fund characteristics explain an additional 4 and 11 percent of variance in profitability for equity and bond funds, respectively. Most of the predictive value of these variables is captured by the Morningstar classifications, however, which explain 75-80 percent of the variance for both equity and bond funds; fund holdings and characteristics only explain about an additional 2-3 percent of variance each.

The results for fund holdings variables are roughly as one might expect. Funds holding foreign equities have higher trading profitability due to higher

predictability for funds holding European, Japanese, and Pacific/Asian equities and higher volatility for those holding Latin American stocks. High predictability for European and Asian but not Latin American equities is consistent with the source of predictability being movements in Western hemisphere markets that are unreflected in closing prices for European and Asian stocks. Funds with smaller market capitalization stocks and higher P/E stocks have higher trading profitability due to higher predictability and higher volatility, respectively. Bond funds with more bonds rated BB, B, and below B have higher profitability due to both higher predictability and higher volatility, while bond funds with longer duration bonds have higher profitability due mainly to the higher price volatility of these bonds.

The results for fund characteristics are less consistent. Larger funds have less predictable returns, especially for bond funds. In addition, bond funds with fewer holdings have less predictable returns. The stronger relationship between size and predictability for bond funds may reflect higher difficulty or cost of adjusting bond prices to reflect market movements. Funds that are closed to new investors have more predictable returns, consistent with these funds being less exposed to short-term trading, but the results for funds with loads or other access restrictions are less significant. High turnover funds tend to have higher NAV volatility, which is consistent with high turnover reflecting an "aggressive" approach.

One might expect that some fund families do a better job of adjusting their NAVs to avoid predictability than others, either because they are more aware of the issue or because their procedures to update prices are more

effective. Family effects on the residual return predictability from the above model are estimated for funds at the 59 fund families with more than 30 funds in the dataset (Table A6), these funds account for 70 percent of funds and 74 percent of assets in the sample. The hypothesis that the effects are all zero is very strongly rejected (with a p-value of less than 10^{-4}); together the effects explain an additional 2 percent of variance in predictability.

In summary, the cross-sectional results imply that variation in predictability and trading strategy profitability comes mainly from differences in asset holdings and less from differences in fund characteristics. These differences are already fairly well reflected in the 48 Morningstar classifications, and, as a result, the cross-sectional variables provide little additional information about trading strategy profitability.

IV Predictability of returns of closed-end funds, index-linked securities, and ADRs

This section tests whether the power of the S&P 500 in predicting NAV changes and movements in small-cap and international indices is reflected in the pricing of closed-end mutual funds, index futures and index-tracking funds (Spiders and WEBS), and ADRs. Instruments that are liquid and primarily institutionally traded (U.S. index futures and Spiders) are found to not have predictable returns, while instruments that are less liquid and traded primarily by individuals (closed-end funds, WEBS, and ADRs) are found to have returns predicted by the prior-day S&P 500. The predictabil-

ity of returns is not so extreme, however, that significant arbitrage opportunities exist once transactions costs are taken into account. This consistent with both weak-form market efficiency and with a small group of investors being aware of these arbitrage possibilities while most individual investors are unaware of them.

Table XI examines the prior-day S&P predictability of returns for the instruments studied in this section. CME-traded index futures do not have significant predictable returns with the exception of the Mexico IPC future. U.S. index-tracking securities also do not have predictable returns. Closed-end funds and European and Western Hemisphere WEBS and ADRs do appear to have predictable returns, however. Table XII tests for predictable returns more directly by testing whether the predictable component of next-day index changes can be used out-of-sample to predict next-day returns. Again, predictability is found for all international closed-end funds and European and Western Hemisphere WEBS and ADRs. For closed-end funds, the hypothesis that predictable and unpredictable index changes influence next-day returns by the same amount cannot be rejected.²⁹ In contrast, although changes in the S&P Mid-cap 400 and Russell 2000 indices are predicted by prior-day changes in the S&P 500, this predictability is fully incorporated in the pricing of U.S. index futures or the Mid-cap Spider.

Table XIII compares the transactions costs for each instrument with the out-of-sample estimated trading profits from a strategy similar to the one described above that makes four roundtrips per year. The instruments with sufficient return predictability to generate roundtrip trading profits of 70

basis points or more all have average effective bid-ask spreads of comparable magnitudes.³⁰ The only instruments in which a trading strategy appears profitable are Western Hemisphere WEBS and ADRs, but this profitability would depend on trading at effective rather than quoted bid-ask spreads.

V Short-term trading fees

Many no-load funds impose short-term trading or purchase fees to discourage investors from using funds for market timing.³¹ These fees are paid into the fund (and thus are not considered loads) and are usually justified as offsetting the trading costs imposed by market timers on other investors. Since short-term trading fees are a means through which fund companies might seek to limit the trading strategy described above, this section examines the extent to which no-load fund companies use these fees and the extent to which the application of these fees suggests that companies are seeking to counter the strategy described above.

Since data on short-term trading and purchase fees are not available in the Morningstar dataset, data was hand collected from the prospectuses of every no-load fund offered to individuals by the seven largest no-load fund families: Fidelity, Vanguard, Janus, T. Rowe Price, American Century, Dreyfus, and Scudder. Information on short-term or purchase fees was available for 408 funds in these families. Of the 325 funds with trading profit opportunities of less than 4 percent per year (estimated in-sample using formula from Section 3.1 and assuming four roundtrip trades per year), 19

percent (63) have fees. The proportion with fees is higher for the 83 funds with profit opportunities greater than 4 percent per year, where 52 percent (43) have fees. But even for the 11 funds with profit opportunities greater than 8 percent per year, only 64 percent (7) have fees. Furthermore, each of the seven families has at least one fund with a profit opportunity of at least 4 percent and no fees.³²

These summary statistics suggest that fees are more common for funds with trading profit opportunities but that opportunities remain even after taking fees into account. This raises the question of whether the fund companies are aware of the profit opportunities and setting their fees in response or whether the fees simply do exist to offset trading costs as stated in the prospectuses. Some evidence is provided by the models in Table XIV, which estimate a probit model (for whether a fund has a short-term or purchase fee) and a tobit model (for the trading profit reduction caused by the fees for a fund with a 4 percent profit opportunity).³³ The independent variables are the predictability and volatility components of trading strategy profit used above.

The results in Table XIV imply that extra trading profit potential coming from predictability is more likely to motivate a short-term trading restriction than trading profit potential coming from volatility.³⁴ This suggests that short-term trading fees are motivated by more than just stopping the trading profit opportunity and that this other motivation is more associated with predictability than volatility. Discouraging short-term flows in funds holding illiquid assets with high trading costs is an obvious candidate for this other

motivation. Running separate regressions for each firm, however, reveals that while the coefficients on predictability and volatility are very different for Dreyfus and Fidelity, they are almost identical for T. Rowe Price and Vanguard,³⁵ and the hypothesis that they are the same cannot be rejected for American Century and Scudder. This suggests that some firms are using short-term trading fees to limit trading profit opportunities, while for other firms, the stated motivation of offsetting transactions costs may be more genuine.

This apparent difference in approach across firms, together with the statistically significant family effects in the models in Table XIV, may suggest differential understanding of the potential for short-term trading profits across firms. It is also possible that the fund families are simply taking different approaches to policing short-term trading, with some using fees and others using more active informal monitoring. The return dilution of 5-6 basis points and 50 basis points for domestic and international equity funds, respectively, calculated by Chalmers, et. al. (1999) and Greene and Hodges (2000) may be a bigger issue for Vanguard, for example, whose investors may be especially return-sensitive, than for other families.

VI Conclusion and implications

The main message of this paper is that mutual fund NAVs are miscalculated in a predictable way and that this miscalculation creates a sizeable trading profit opportunity that is larger than previously reported. This trading

profit potential represents both an opportunity for investors and a threat to the returns to buy-and-hold investors, a threat that the 50 basis point return dilution calculated by Greene and Hodges (2000) for international funds suggests is becoming significant. Given that the international funds in the Morningstar universe have assets of roughly \$400 billion; this 50 basis point return dilution estimate combines with my estimate of a four-roundtrip trading strategy profitability of roughly 10 percent to suggest that there is effectively \$20 billion pursuing this strategy.³⁶

The currently common fund company policy of selectively disciplining investors who trade on NAV predictability raises further questions. The Investment Company Act of 1940 prohibits a fund from selling shares at less than NAV in order to protect existing shareholders from dilution. By calculating NAVs in a way that makes them predictability above or below the true value of a fund's assets, however, a fund is effectively offering informed investors the opportunity to buy at a discount and sell at a premium. This is violation of the spirit, if not the letter, of the law. If a fund company selectively allowed an investor to trade based on NAV predictability at maximum frequency, that investor would earn excess returns of 36 percent at the expense of the other shareholders of the fund. Given the current concern over brokerage firms providing soft-money kickbacks to fund companies in exchange for order flow, one might also be concerned about soft-money being used to buy the right to short-term trade. The average international equity fund with assets of \$330 billion spends roughly \$800,000 on brokerage commissions per year.³⁷ Allowing a brokerage house to short-term trade \$2

million at maximum frequency would be as valuable to them as all of this commission revenue (more valuable considering order fulfillment costs).³⁸

Fund companies can eliminate the possibility of trading on NAV predictability by either: 1) increasing the size and universality of short-term trading fees, or 2) adjusting last-trade equity prices and improving the formulas used for bond pricing adjustments to reduce NAV predictability. Based on the trading profitability estimates in this paper, using the first solution alone would require fees of roughly 3 percent and 2 percent for international and U.S. small-cap equity funds, respectively. Fees of this magnitude may not be readily accepted by current no-load fund investors, and may be difficult for one fund company to impose unilaterally (a coordinated imposition of these fees may violate anti-trust laws). The alternative of adjusting equity prices has been not adopted by fund companies due in part to concerns that any adjustment policy could be subject to manipulation, potentially exposing the fund company to legal action. The potential for manipulation could be reduced by relying on third-party price adjustment services as is currently done for bond funds. Adjusting last-trade equity prices to reflect their “fair value” is currently legal and allowed for in most fund prospectuses. No price adjustment methodology is likely to be perfect; to appreciate the difficulty of eliminating predictability note that high-yield bond fund predictability is exacerbated by the current price methodology and that a proposed methodology of adjusting international equity prices using ADRs or WEBS would not eliminate predictability since these instruments themselves have predictable returns. Any price adjustment method-

ology needs to be carefully scrutinized and should probably be combined with an increase in the universality and, if necessary, the size of short-term trading fees.

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Notes

¹For an overview of the literature on serial correlation of portfolio returns, see Campbell, Lo, and MacKinlay (1997), Chapters 2 and 3. Papers on the contribution of non-synchronous trading to the serial correlation include Lo and MacKinlay (1990), Boudoukh, Richardson, and Whitelaw (1994) and Kadlec and Patterson (1999).

²See, for example, Knez and Ready (1996).

³This commitment is not absolute, since most mutual funds do reserve the right to refuse purchases or make large redemptions (e.g., greater than \$250,000) in kind. This right is rarely exercised, however.

⁴Funds are allowed to update closing prices used in calculating NAVs under the 1940 Investment Company Act by substituting the “fair value” of the asset.

⁵Bhargava et. al. (1998), Chalmers, et. al. (1999), and Greene and Hodges (2000) report excess returns of 8 percent, 2.5 percent, and 10-20 percent trading international funds based trading frequencies of six roundtrips per year, four roundtrips per year, and unlimited trading (roughly 60 roundtrips per year), respectively.

⁶The greatest difference is with Chalmers, et. al. (1999) who report excess returns to a four-roundtrip trading strategy of 1.2 and 2.5 percent for U.S. equity and international funds, respectively. The sources of the difference in estimates with this paper are discussed in Section II.C.

⁷This dataset is thus more comprehensive than the TrimTabs dataset that is used by Chalmers et. al. (1999) and Greene and Hodges (2000),

which covers 929 funds. The TrimTabs data does have the advantage of including daily flow data, which Chalmers et. al. and Greene and Hodges use to estimate the losses to buy-and-hold investors caused by trading on NAV predictability. The dataset used in this paper is also larger than the sample of five international funds examined by Bhargava, et. al. (1998).

⁸For the years 1997, 1998, and 1999 the sample is fairly complete, with data for 80, 88, and 98 percent of the days the funds in the sample were in existence, respectively. For 1996 and 1995 (which was dropped from the sample) the corresponding figures are 47 and 24 percent. Although the partial sample in 1996 suggests the possibility of a sample selection bias, 1996 accounts for only 7 percent of the sample and thus is unlikely to have a large effect on the results. Results by year will be examined in Section II.D; they are fairly consistent over time.

⁹The dividend data available was very incomplete, with only 1,500 observations compared with 6.1 million daily NAVs.

¹⁰For bond and money market funds, dividends are often accrued and subtracted from net asset values daily, while capital gains distributions are usually accrued once a year on a recording date (usually in December) as they are with equity funds.

¹¹Non-inclusion of distributions is also a problem with the TrimTabs daily NAV dataset. Chalmers, et. al. (1999) and Greene and Hodges (2000) also conclude that this is not a serious problem.

¹²For example, an error of 5 percent every 200 trading days would lead measured serial correlation to be biased downward and towards zero, with

$\hat{\rho} = \frac{7}{8} \cdot \rho - \frac{1}{7}$. If dividends were issued following days with average excess returns of 20 basis points (I found no evidence of any relationship), the coefficient on past-day market returns would be biased downward by one percentage point.

¹³To test whether adjustments to closing prices are more common on days with large market movements, S&P predictability coefficients were estimated for international and U.S. small-cap equity funds and unadjusted portfolios for days following large S&P 500 movements (with an absolute value greater than 1.5 percent). In all cases, the coefficients for days with large and small changes were within one percentage point of each other.

¹⁴Regressions of returns on 2-day lagged returns and the prior-day ten-year bond yield and S&P 500 change have r-squareds of 0.027 and 0.129 for the unadjusted high-yield bond portfolio and an equal-weight portfolio of high-yield bond funds, respectively.

¹⁵About 50 percent of the fund distributions for which we do have data were paid on Friday, so the non-inclusion of distributions may bias the estimated day effects. In particular, if reported returns were 5 percent too low once every 100 days, and 50 percent on these errors were on Friday; the Friday effect would be biased *downward* by about 9 basis points. Thus Table III may be an underestimate of the size of the Friday effect.

¹⁶Table IV contains results for 9 broad groupings of funds; the results for all 48 Morningstar categories are in Table A2.

¹⁷For intra-day S&P changes I use TAQ data for the S&P 500 Spider. The spider is traded very frequently (an average of 80 times per hour from

1993-99) and its narrow bid-ask spread suggests that it should be efficiently priced.

¹⁸Almost all fund families allow transactions up to 4:00 PM; a few even allow one to cancel transactions after 4:00 PM but before NAVs are reported at 5:30 PM. Given the speed of online fund transactions, I will assume for simplicity that investors can make decisions after observing the closing values of U.S. market indices. If this assumption is not literally valid, it is off by only a few minutes.

¹⁹These alphas are probably overestimates given that the Morningstar sample is not free of survivorship bias.

²⁰The above assumes average round-trip trading costs of 80 basis points for each asset class.

²¹The regression model used in this section does not include category-specific indices (Table V) or intra-day S&P 500 changes. The trading strategy profitability numbers reported in this section may therefore be underestimates of the profitability actually achievable for specialty, U.S. small-cap, and European or Asian equity funds.

²²Specifically, fund returns are regressed on dummies for days following buy and sell triggers (methodology 2) or days when the fund is owned (methodology 3). In the CAPM model the return on the S&P 500 is included as the proxy for the market return, while the “multi-factor” model also includes the changes in the Russell 2000 and the MSCI indices that could not be predicted from prior-day index changes. It is important to control only for the unpredictable changes in these indices when estimating

excess returns since controlling for the predictable changes would lead to an underestimate of the profitability of the strategy (since the whole point of the strategy is that these index changes are predictable). Only the CAPM-adjusted estimates are reported in Table V; all the estimates are reported in Table A4.

²³To control for any bias due to the non-inclusion of dividend and capital gain distributions in returns, which would occur if the probability of holding the fund under the trading strategy was different than average in periods when dividends were paid, trading strategy profitability was estimated with and without a December month dummy variable. The results were extremely similar, so only the results without the December dummy are reported.

²⁴The results are also very similar for the entire 1996-99 and fairly similar for longer time periods (discussed below).

²⁵Only the prior-day S&P 500 is used for simplicity and since daily data on all the market indices used in the full model were not available before 1996.

²⁶An important caveat is that the sample is very limited before 1996. When the exercise is replicated using only those funds for which data from 1986-1999 was available, however, very similar results are obtained.

²⁷Although there is no theoretical reason to expect these dependent variables to be normally distributed, and thus good candidates for linear regression, they do turn out to be approximately normal. The skewness and kurtosis of σ_{pred} is 1.7 and 6.0, respectively, compared with -0.8 and 4.0 for $\ln(\sigma_{pred})$.

²⁸Short-term trading and purchase fees paid into the fund are not counted as loads and are not reported in the Morningstar data. They had to be hand collected for a subsample of 561 no-load funds and will be discussed in Section IV.

²⁹Table A6 reveals that predictable changes in closed-end fund NAVs can also be used to predict next-day returns and that again the hypothesis that predictable and unpredictable NAV changes influence next-day returns by the same amount cannot be rejected.

³⁰Effective bid-ask spreads are calculated as twice the average of the absolute value of the difference between the trade price and the mean of the bid-ask quotes (Huang and Stoll, 1994).

³¹Most funds, even those without short-term transaction fees, also reserve the right to reject purchases from investors with a history of short-term trading or impose extra short-term redemption fees on such investors. The most common definition of short-term trading is more than four roundtrip trades per year in any given fund.

³²Fund supermarkets and brokerages often charge short-term trading fees in addition to those charged by the funds. For brokerages, however, these fees are usually fixed (\$25 and \$35 for E-Trade and DLJ Direct, respectively), so they become negligible for moderate volume transactions.

³³See Table XIV for the formula used to calculate the trading profit reduction.

³⁴This result is consistent with the observation that 75 percent of high-yield funds in the sample have fees but only 53 percent of international funds

do.

³⁵Almost identical here means within 0.05.

³⁶The return dillution estimates by Greene and Hodges cannot distinguish between fund flows that are deliberately timed to take advantage of NAV predictability and flows that are simply lucky; the \$20 billion may be an overestimate if fund flows into international funds are higher on days the U.S. market is rising for other reasons. The \$20 billion estimate also assumes a four-roundtrip per year strategy; \$6 billion pursuing maximum trading frequency strategy is also consistent with the return dillution reported by Greene and Hodges.

³⁷This is a rough estimate based on data from one international fund.

³⁸I am merely illustrating the potential for abuse; I have no evidence that this practice actually occurs.

Table II. NAV volatility, serial correlation, S&P predictability, and contribution to predictive model from best other index.

The volatility, one and two-day lag serial correlation, S&P predictability, and predictive contribution from the best other market index are summarized for nine broad groupings of funds (Table A2 presents results for all 48 Morningstar classifications). The two serial correlation coefficients and the S&P coefficient are all estimated in separate regressions. Equity funds have 4-5 times more NAV volatility than bond funds. Only municipal and high-yield bond funds display evidence of long-lagged serial correlation. Bond yields are the best additional index for most bond funds, while small cap and other international equity indices provide the most additional predictive power for equity and high-yield funds. The candidate indices are the Dow Jones Bond and Utilities indices, the Russell 2000, the NASDAQ composite, the Philadelphia Gold and Silver index, the 13-week, 5-year, 10-year, and 30-year treasury bond yields, and the all-country free versions of the MSCI Foreign, Europe, Asia-Pacific, Asia-Pacific Ex. Japan, Japan, Emerging Market, and Latin America indices. Standard errors are heteroskedasticity robust and adjusting for clustering within trading days

	Funds	Std. Dev. (dNAV)	1-day lag dNAV		2-day lag dNAV		1-day lag S&P 500		Adjusted R-sq		Best index
			Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	S&P only	With best index	
International equity	1,146	1.2	0.14	0.02	0.00	0.03	0.33	0.03	0.097	0.108	MSCI Emerging Market
Small-cap U.S. Equities	672	1.2	0.15	0.04	0.03	0.04	0.15	0.04	0.019	0.030	Russell 2000
Mid-cap U.S. Equities	706	1.3	0.09	0.03	0.00	0.03	0.13	0.04	0.012	0.014	Russell 2000
Large-cap U.S. Equities	1,761	1.2	0.03	0.03	0.00	0.03	0.06	0.04	0.001	0.002	MSCI Europe
Specialty U.S. equity funds	446	1.3	0.12	0.02	0.01	0.02	0.09	0.03	0.006	0.008	Philadelphia Gold & Silver
High-yield corporate bonds	250	0.3	0.20	0.03	0.17	0.02	0.05	0.01	0.045	0.065	Russell 2000
Corporate Bonds (Investment Grade)	757	0.3	0.04	0.02	0.03	0.02	0.01	0.01	0.003	0.010	10-year Treasury
Government Bonds	462	0.3	0.03	0.02	0.02	0.02	0.01	0.01	0.001	0.007	10-year Treasury
Municipal Bonds	1,679	0.2	0.07	0.03	0.09	0.02	0.01	0.00	0.003	0.025	10-year Treasury

Table III. Day of the week effects for equity mutual funds and unadjusted portfolios of similar assets

Day of the week effects for funds and unadjusted portfolios (identical to those in Table 1) are compared. The standard deviation of the effects is slightly larger in the funds, suggesting that bid-ask bounce is not a major cause of these effects or that mutual funds do not adjust for bid-ask bounce as many claim to in their prospectuses. The day of the week effects are collectively significant at the 10% level or better for all U.S. equities, decile 10 and Latin America, but not deciles 6-9, Europe, or Asia. Standard errors are heteroskedasticity-robust and adjusted for clustering of fund returns within each trading day.

Asset type	No. of Funds	Standard deviation of day effects		Unadjusted portfolios										Funds				
		Port.	Funds	Mon.	Tues.	Wed.	Thurs.	Fri.	Avg. SE	Mon.	Tues.	Wed.	Thurs.	Fri.	Avg. SE			
U.S. equities	2,821	13	14	-2	16	0	-19	5	8	-7	16	7	-20	6	6			
Market cap decile 6	22	8	11	-8	0	3	-6	12	7	-13	5	10	-9	9	7			
Market cap decile 7	35	9	10	-9	4	4	-10	9	7	-8	9	5	-12	8	7			
Market cap decile 8	191	9	12	-9	6	4	-10	8	7	-8	9	9	-16	8	9			
Market cap decile 9	411	9	13	-6	8	7	-13	6	7	-10	9	11	-17	8	8			
Market cap decile 10	2,162	14	15	-3	18	-1	-21	5	8	-7	18	6	-21	5	7			
International equities	1,049	5	7	7	7	8	-5	2	6	2	9	11	-6	4	6			
Europe	102	6	6	13	9	8	-3	5	6	7	9	7	-7	4	7			
Japan	35	10	10	-10	10	9	2	-11	11	0	16	17	11	-5	10			
Asia-Pacific ex. Japan	85	6	9	-1	-7	5	-6	6	9	-7	-6	12	-5	8	10			
Latin America	35	19	21	-7	17	10	-25	22	12	-9	16	16	-30	17	14			

Table IV. Regression model predicting one-day NAV changes

Log NAV changes are predicted using prior-day market index changes and two-day lagged NAV changes for the same fund and the equal-weighted category average. Results for all 48 Morningstar classifications are in Table A3. Two-day lagged NAV changes are significant only for high-yield and municipal bond funds, consistent with Table 2. The Russell 2000 is a better predictor than the S&P 500 for U.S. equity and high-yield funds. Bond yields are significant for most bond funds but not high-yield or equity funds. Standard errors are heteroskedasticity-robust and adjusted for clustering of fund returns within each trading day.

	2-day lagged dNAV's		Prob(F)	R-sq	SD(pred)	MSCI Indices						
	Own fund	Category				S&P 500	Russell 2000	10-year	Europe	Asia x Jap.	Japan	Lat. Am.
International equity	-0.006 (0.006)	0.008 (0.035)	0.00	0.114	0.40	0.205 (0.050)	0.051 (0.062)	0.018 (0.033)	0.059 (0.039)	-0.008 (0.033)	-0.029 (0.020)	0.074 (0.024)
Small-cap U.S. Equities	-0.009 (0.009)	0.035 (0.058)	0.02	0.036	0.24	-0.006 (0.073)	0.240 (0.084)	0.004 (0.047)	-0.089 (0.058)	0.019 (0.039)	-0.032 (0.030)	0.019 (0.034)
Mid-cap U.S. Equities	-0.014 (0.007)	0.006 (0.056)	0.06	0.014	0.16	0.011 (0.070)	0.109 (0.081)	-0.002 (0.047)	-0.014 (0.057)	0.023 (0.039)	-0.039 (0.028)	0.026 (0.034)
Large-cap U.S. Equities	-0.013 (0.008)	-0.001 (0.051)	0.09	0.006	0.10	-0.021 (0.066)	0.041 (0.077)	-0.018 (0.045)	0.070 (0.056)	0.011 (0.039)	-0.034 (0.027)	0.015 (0.034)
Specialty U.S. equity funds	-0.012 (0.008)	0.014 (0.030)	0.07	0.009	0.13	-0.042 (0.050)	0.109 (0.058)	-0.022 (0.033)	0.023 (0.043)	0.012 (0.029)	-0.031 (0.021)	0.027 (0.025)
High-yield corporate bonds	0.002 (0.007)	0.456 (0.045)	0.00	0.151	0.11	0.005 (0.010)	0.047 (0.013)	-0.007 (0.007)	0.005 (0.007)	-0.009 (0.005)	-0.005 (0.006)	0.016 (0.004)
Corporate Bonds (Investment Grade)	-0.007 (0.006)	0.042 (0.031)	0.03	0.012	0.03	0.007 (0.011)	0.007 (0.013)	-0.021 (0.008)	-0.002 (0.009)	0.001 (0.006)	-0.006 (0.006)	0.000 (0.005)
Government Bonds	0.004 (0.011)	0.018 (0.023)	0.08	0.010	0.03	0.009 (0.010)	0.003 (0.013)	-0.021 (0.008)	-0.002 (0.009)	0.000 (0.006)	-0.006 (0.005)	-0.001 (0.005)
Municipal Bonds	-0.006 (0.004)	0.146 (0.035)	0.00	0.040	0.04	0.013 (0.007)	-0.003 (0.009)	-0.024 (0.006)	0.000 (0.006)	-0.001 (0.004)	-0.003 (0.003)	-0.004 (0.003)

Table V. Improvement to predictive model for specialty funds from using category-specific index
Dependent variable: next-day NAV change

For natural resource, precious metals, and real estate funds the predictive model in Table IV can be improved upon using the change in the U.S.-based category-specific index (the AMEX Oil Stock Index, the Philadelphia Gold & Silver Index, and the Morgan Stanley REIT Index). The standard deviation of predicted returns and r -squared are given for the model in Table IV with and without the category-specific index. The regression coefficients for the category 2-day lag, the best fitting equity market index (S&P 500 for natural resources and real estate; MSCI Europe for precious metals), and the category-specific index are estimated in a separate regression for clarity. Once the category-specific index is controlled for, the predictive power of the broad equity market disappears for natural resources and real estate, implying that specialty funds may provide an alternative to cash on days the general equity market is falling. Return predictability is especially high for international specialty funds (defined as funds with over 35 percent non-U.S. assets); all precious metal funds but only two real estate funds are international under this definition. Standard errors are heteroskedasticity-robust and adjusted for clustering of returns within trading days.

Specialty - Natural Resource	All (53 funds)	SD(pred)	R-sq.	Category 2-day lag dNAV		S&P 500/MSCI Europe		U.S. category-specific index	
				Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Specialty - Precious Metals	International	0.21	0.025	0.06	0.04	0.11	0.04	0.13	0.04
	(16 funds)	0.20	0.029	0.09	0.04	0.11	0.04	0.13	0.04
	International	0.22	0.055	0.08	0.04	0.00	0.05	0.18	0.04
Specialty - Real Estate	(36 funds)	0.43	0.063	-0.05	0.04	0.17	0.07		
	All	0.24	0.088	-0.04	0.04	0.13	0.07	0.13	0.02
	(84 funds)	0.28	0.121	0.19	0.06	0.10	0.02	0.32	0.06
				0.08	0.06	0.02	0.03		

Table VI. Profitability of trading strategy involving four roundtrip trades per year

The profitability of a trading strategy making four roundtrip trades per year is estimated using three methodologies. For each methodology, profitability is defined as the difference between the strategy and buying and holding the fund and cash in proportion to the number of days spent in each under the strategy. Methodology 1 is to assume serially uncorrelated and normally distributed expected returns and use the formula in Section 3.1, which involves multiplying the standard deviation of predicted returns by a profit factor that is a function of the number of roundtrip trades. Methodology 2 estimates profitability as the difference in returns following buy and sell days times the number of roundtrip trades per year. Methodology 3 simulates a trading strategy of buy on a buy trigger and then holding until the next sell trigger. The in-sample estimate is for the entire 1996-99 period; the out-of-sample estimates use 1995-96 data to estimate the predictive model and 1997-99 to estimate profitability. Profitabilities in methodologies 2 and 3 are estimated as returns unexplained by the S&P 500 return. Standard errors are heteroskedasticity-robust and adjusted for clustering of fund returns within each trading day.

	Methodology 1		Methodology 2		Methodology 3	
	Estimated from standard deviation of predicted next-day NAV change		Out-of-sample		Out-of-sample	
	In-sample	Out-of-sample	Coef.	S.E.	Coef.	S.E.
International equity	7.2	7.1	8.6	1.2	11.8	3.8
Small-cap U.S. Equities	4.3	3.8	6.0	1.2	7.5	3.5
Mid-cap U.S. Equities	2.8	1.7	3.4	0.9	6.2	2.4
Large-cap U.S. Equities	1.8	0.5	0.4	0.2	-0.9	0.9
Specialty U.S. equity funds	2.3	1.5	2.2	0.6	8.4	2.1
High-yield Bonds	1.9	1.9	1.9	0.3	4.0	0.8
Corporate Bonds (Investment Grade)	0.5	0.3	0.3	0.3	2.1	1.0
Government Bonds	0.5	0.3	0.6	0.3	0.6	1.1
Municipal Bonds	0.7	0.5	0.4	0.1	1.1	0.7

Table VII. Reconciliation of this study with Chalmers, et. al. (1999)

Estimates of excess returns to a trading strategy with four roundtrip trades per year

This table reconciles the differences between the trading strategy profitability estimates in this study and the much lower estimates in Chalmers et. al. (1999). Very little of the difference is accounted for by differences in sample (this paper has data on 8,763 out of 9,220 funds with a ticker symbol, compared with 929 in Chalmers, et. al.) or time period. The major differences in this paper are the more selective triggers (Chalmers, et. al. estimate the profitability of a four roundtrip trade per year strategy assuming trading on top and bottom quartile days), use of market indices other than the S&P 500 for prediction, and the fact that the simulation allows for drift following buy and sell triggers.

	All U.S. equity funds	U.S. Small-Cap equity	International	Emerging market only
Chalmers, et. al. (1999) result	1.2	N/A	2.5	N/A
Replication using this dataset	0.9	1.9	3.7	5.4
(International equity funds only)				
1998-99 data instead of 2/98-7/99	1.0	2.0	4.2	5.4
1.85 SD rule instead of top 25%	1.4	3.2	8.3	8.7
Full model instead of S&P only model	1.7	6.6	8.6	10.2
Simulation instead of next-day returns	4.0	11.7	11.8	17.2
Memo: returns to maximum frequency trading				
Methodology 2: next-day returns	7.1	17.6	36.5	45.3
Methodology 3: simulated returns	7.1	17.9	36.1	44.6

Notes:

1. The figures from Chalmers, et. al. (1999) calculated by the authors from the difference between fund returns following days with S&P 500 returns in the top and bottom quartile.
2. Chalmers, et. al. include international bond funds in their international category
3. Full model and simulation results are same as columns 2 and 5 in Table 5.
4. Chalmers et. al. estimate a profitability of 1.8 percent for "aggressive" U.S. equity funds which include smaller cap, higher volatility stocks. This is roughly consistent but not strictly comparable with my estimate of 1.9 percent for Morningstar Small-Cap equity funds.
5. Emerging market equity funds refer to the Morningstar classifications "Diversified Pacific/Asia", "Diversified Emerging Market", "Latin American Stock", and "Pacific/Asia Ex. Japan Stock"

Table VIII. Summary statistics for cross-sectional analysis

Summary statistics for the variables used in the analysis of how trading strategy profitability and its determinants, NAV predictability and volatility, vary with fund holdings and characteristics.

		Equity funds		Bond funds	
Number of funds					
Morningstar universe, with some NAV data		5485		3278	
With sufficient NAV data to estimate dep. variables		5072		3096	
With dep. var. & holdings		3998		2316	
With dep. var., holdings, and fund characteristics		3004		1981	
Dependent variables		Mean	S.D.	Mean	S.D.
Trading strategy profitability	[Log(SD(pred))]	-6.2	0.6	-7.7	0.6
NAV predictability	[Log(R)]	-1.8	0.6	-1.6	0.4
NAV volatility	[Log(SD(fund))]	-4.5	0.3	-6.1	0.6
Fund characteristics					
Log(Fund assets, \$millions)		4.7	2.0	4.1	1.9
Log(Num of holdings)		4.6	0.8	4.7	0.9
Morning star rating (1-5 stars)		3.1	1.1	3.1	1.1
Asset turnover (per year)		0.84	0.70	0.80	0.97
Expense ratio (percent)		1.50	0.69	1.06	0.48
Has load (on purchases or sales)		0.56	0.50	0.64	0.48
Closed to new investors		0.03	0.17	0.01	0.12
Qualified investors only		0.03	0.16	0.01	0.12
Institutional investors only		0.17	0.38	0.15	0.36
Equity fund holdings					
Median market cap (\$ billions)		23.0	24.5		
Median P/E ratio		31.4	7.6		
Assets by region					
North America		0.73	0.38		
Europe		0.14	0.25		
Japan		0.04	0.11		
Latin America		0.02	0.10		
Pacific/Asia Ex. Japan		0.05	0.17		
Other		0.02	0.07		
Assets by industry					
Finance		0.17	0.14		
Utilities		0.03	0.07		
Energy		0.05	0.06		
Industrial cyclicals		0.13	0.11		
Consumer durables		0.04	0.04		
Consumer staples		0.05	0.04		
Services		0.18	0.10		
Retail		0.06	0.04		
Health		0.09	0.09		
Technology		0.18	0.14		
Bond fund holdings					
Average bond duration (years)				6.0	2.1
Government bond share				0.09	0.21
Assets by S&P credit rating					
AAA				0.44	0.26
AA				0.13	0.12
A				0.15	0.14
BBB				0.12	0.12
BB				0.04	0.08
B				0.05	0.16
Below B				0.01	0.03
Not rated				0.06	0.12

Table IX. Determinants of predictability and trading strategy profitability -- equity funds

The econometric determinants of the trading strategy profitability, NAV predictability, and NAV volatility of equity funds

Specification	OLS			Fund category fixed effects		
Dependent variable	SD(pred)	R	SD(fund)	SD(pred)	R	SD(fund)
Median market cap (\$ billions)	-0.0051 (0.0003)	-0.0044 (0.0003)	-0.0007 (0.0002)	-0.0013 (0.0003)	-0.0016 (0.0003)	0.0003 (0.0002)
Median P/E ratio	0.0015 (0.0017)	-0.0066 (0.0015)	0.0081 (0.0011)	0.0028 (0.0016)	0.0010 (0.0015)	0.0018 (0.0010)
By region:						
Europe	1.10 (0.03)	1.16 (0.03)	-0.06 (0.02)	0.71 (0.08)	0.87 (0.07)	-0.15 (0.05)
Japan	1.01 (0.07)	1.16 (0.07)	-0.16 (0.05)	0.80 (0.15)	1.22 (0.14)	-0.41 (0.09)
Latin America	0.18 (0.08)	-0.37 (0.07)	0.55 (0.05)	0.33 (0.18)	-0.36 (0.18)	0.70 (0.11)
Pacific/Asia Ex. Japan	1.22 (0.04)	1.00 (0.04)	0.22 (0.03)	0.94 (0.14)	1.16 (0.13)	-0.23 (0.09)
Other	0.68 (0.11)	0.79 (0.10)	-0.11 (0.07)	0.46 (0.10)	0.75 (0.10)	-0.29 (0.06)
By industry:						
Utilities	-0.84 (0.10)	-0.58 (0.09)	-0.26 (0.06)	-0.38 (0.14)	0.04 (0.13)	-0.41 (0.09)
Energy	-0.86 (0.13)	-0.93 (0.12)	0.07 (0.08)	-0.59 (0.15)	-0.72 (0.14)	0.13 (0.09)
Industrial cyclicals	-0.18 (0.07)	-0.52 (0.06)	0.34 (0.05)	-0.37 (0.10)	-0.25 (0.09)	-0.12 (0.06)
Consumer durables	-0.31 (0.21)	-0.36 (0.19)	0.05 (0.14)	0.07 (0.18)	0.18 (0.17)	-0.11 (0.11)
Consumer staples	-1.35 (0.17)	-1.03 (0.15)	-0.32 (0.11)	-0.39 (0.16)	0.02 (0.15)	-0.41 (0.10)
Services	0.27 (0.08)	0.16 (0.07)	0.11 (0.05)	0.15 (0.09)	0.22 (0.09)	-0.07 (0.06)
Retail	0.40 (0.15)	-0.13 (0.14)	0.53 (0.10)	0.19 (0.14)	-0.05 (0.14)	0.24 (0.09)
Health	-0.09 (0.08)	-0.25 (0.08)	0.16 (0.06)	-0.22 (0.12)	-0.09 (0.12)	-0.13 (0.08)
Technology	0.61 (0.08)	-0.07 (0.08)	0.68 (0.06)	0.23 (0.10)	-0.17 (0.09)	0.40 (0.06)
Log(Fund assets, \$millions)	-0.023 (0.004)	-0.021 (0.003)	-0.002 (0.002)	-0.035 (0.003)	-0.020 (0.003)	-0.015 (0.002)
Log(Num of holdings)	-0.060 (0.008)	0.010 (0.007)	-0.070 (0.005)	-0.032 (0.007)	-0.017 (0.006)	-0.015 (0.004)
Morning star rating (1-5 stars)	-0.054 (0.007)	-0.052 (0.006)	-0.002 (0.005)	0.004 (0.006)	0.007 (0.006)	-0.003 (0.004)
Asset turnover (per year)	0.023 (0.009)	0.008 (0.008)	0.015 (0.006)	0.045 (0.007)	0.009 (0.007)	0.036 (0.005)
Expense ratio (percent)	0.036 (0.012)	0.030 (0.011)	0.006 (0.008)	0.007 (0.009)	0.005 (0.009)	0.002 (0.006)
Has load (on purchases or sales)	-0.004 (0.015)	-0.052 (0.014)	0.048 (0.010)	0.031 (0.012)	-0.010 (0.011)	0.041 (0.007)
Closed to new investors	0.114 (0.035)	0.149 (0.032)	-0.035 (0.024)	0.028 (0.029)	0.031 (0.027)	-0.003 (0.018)
Qualified investors only	0.048 (0.037)	-0.019 (0.033)	0.068 (0.025)	0.025 (0.029)	-0.021 (0.028)	0.046 (0.018)
Institutional investors only	0.096 (0.019)	0.006 (0.017)	0.091 (0.013)	0.067 (0.015)	-0.005 (0.014)	0.072 (0.009)
Share of variance explained by.						
Morningstar category fixed effects	N/A	N/A	N/A	0.77	0.79	0.60
Fund holdings	0.67	0.71	0.32	0.03	0.02	0.05
Fund characteristics	0.04	0.02	0.08	0.02	0.01	0.03
Residual	0.29	0.27	0.60	0.18	0.18	0.32

Notes:

1. The omitted region and industry are North America and financial services, respectively

Table X. Determinants of predictability and trading strategy profitability -- bond funds

The econometric determinants of the trading strategy profitability, NAV predictability, and NAV volatility of bond funds.

Specification	OLS			Fund category fixed effects		
Dependent variable	SD(pred)	R	SD(fund)	SD(pred)	R	SD(fund)
Average bond duration (years)	0.087 (0.005)	0.033 (0.004)	0.055 (0.006)	0.042 (0.005)	0.001 (0.004)	0.041 (0.004)
Government bond share	0.18 (0.06)	-0.37 (0.04)	0.55 (0.07)	0.02 (0.04)	0.02 (0.03)	0.00 (0.04)
Assets by S&P credit quality:						
AA	0.20 (0.10)	0.44 (0.07)	-0.24 (0.11)	0.20 (0.06)	0.13 (0.05)	0.07 (0.05)
A	0.36 (0.09)	-0.52 (0.06)	0.89 (0.10)	0.01 (0.06)	-0.12 (0.05)	0.13 (0.05)
BBB	-0.15 (0.09)	-0.12 (0.06)	-0.03 (0.11)	0.05 (0.06)	0.09 (0.05)	-0.04 (0.05)
BB	1.30 (0.16)	-0.05 (0.10)	1.35 (0.18)	0.16 (0.10)	0.05 (0.08)	0.12 (0.09)
B	1.05 (0.09)	1.07 (0.06)	-0.02 (0.10)	0.04 (0.09)	0.19 (0.08)	-0.15 (0.08)
Below B	1.40 (0.32)	0.49 (0.22)	0.91 (0.38)	0.86 (0.22)	0.53 (0.18)	0.33 (0.20)
Not rated	-0.11 (0.09)	0.09 (0.06)	-0.20 (0.10)	-0.27 (0.05)	-0.11 (0.04)	-0.16 (0.05)
Log(Fund assets, \$millions)	-0.001 (0.007)	-0.051 (0.005)	0.050 (0.008)	-0.030 (0.004)	-0.045 (0.003)	0.016 (0.004)
Log(Num of holdings)	0.084 (0.014)	0.044 (0.009)	0.040 (0.016)	0.042 (0.009)	0.074 (0.007)	-0.032 (0.008)
Morning star rating (1-5 stars)	-0.138 (0.012)	-0.001 (0.008)	-0.137 (0.014)	-0.065 (0.007)	0.002 (0.006)	-0.066 (0.007)
Asset turnover (per year)	0.047 (0.011)	-0.023 (0.007)	0.070 (0.013)	0.015 (0.007)	0.001 (0.006)	0.014 (0.007)
Expense ratio (percent)	0.221 (0.029)	-0.078 (0.019)	0.299 (0.033)	-0.009 (0.018)	0.011 (0.015)	-0.020 (0.016)
Has load (on purchases or sales)	-0.218 (0.028)	0.072 (0.019)	-0.290 (0.032)	-0.051 (0.017)	-0.012 (0.014)	-0.038 (0.016)
Closed to new investors	0.088 (0.085)	0.100 (0.057)	-0.012 (0.098)	0.108 (0.050)	0.040 (0.042)	0.068 (0.046)
Qualified investors only	0.135 (0.082)	0.003 (0.056)	0.133 (0.095)	0.014 (0.049)	-0.004 (0.041)	0.018 (0.044)
Institutional investors only	0.091 (0.034)	0.029 (0.023)	0.061 (0.039)	0.062 (0.020)	0.021 (0.017)	0.041 (0.018)
Share of variance explained by:						
Morningstar category fixed effects	N/A	N/A	N/A	0.77	0.67	0.84
Fund holdings	0.32	0.41	0.22	0.02	0.01	0.01
Fund characteristics	0.11	0.04	0.10	0.02	0.04	0.01
Residual	0.57	0.55	0.68	0.19	0.28	0.14

Notes:

1. AAA is the omitted credit quality category.

Table XI. Predictability of exchange-traded fund price changes using prior day S&P 500
Dependent variable: Log percentage change in price

The predictability of price changes from the prior-day S&P 500 is examined for index futures, U.S. index securities, World Equity Benchmark Shares (WEBS), sector-specific index securities, ADRs, and closed-end mutual funds. The results suggest that the pricing of general and sector-specific index securities, most index futures, and Asia-Pacific WEBS and ADRs is efficient, but that price changes of closed-end funds and other WEBS and ADRs are predictable. Standard errors are heteroskedasticity-robust and adjusting for clustering within trading days.

				S&P 500	
	Number	Obs.	Prob(F)	Coeff.	S.E.
Index futures					
S&P 500	8	5,209	0.27	-0.07	0.06
S&P Mid 400	4	2,688	0.68	-0.02	0.58
NASDAQ 100	3	2,028	0.14	-0.14	0.09
Russell 1000	1				
Russell 2000	4	2,678	0.80	-0.02	0.06
Nikkei 225	4	2,680	0.88	0.01	0.07
Mexico IPC	4	2,677	0.00	0.20	0.07
U.S. Index-linked funds (Spiders)					
Dow Jones (DIA)	1	469	0.16	-0.07	0.05
S&P 500 (SPY)	1	1,701	0.04	-0.05	0.03
S&P Mid 400 (MDY)	1	1,059	0.63	-0.02	0.03
NASDAQ 100 (QQQ)	1	194	0.70	0.05	0.13
Sector index securities (XL*)	9	2,176	0.82	0.01	0.05
All WEBS (EW*)	16	13,144	0.20	0.08	0.06
North American WEBS	2	1,642	0.02	0.22	0.09
European WEBS	10	7,915	0.02	0.12	0.05
Pacific WEBS	4	3,587	0.47	-0.07	0.10
ADRs	444	302,215	0.04	0.11	0.05
European ADRs	183	122,470	0.01	0.12	0.05
Latin American ADRs	85	64,854	0.02	0.18	0.08
Pacific ADRs	86	69,360	0.73	0.02	0.07
Closed-end funds	517	882,382	0.00	0.07	0.01
World equity	72	148,080	0.00	0.16	0.05
U.S. Equity	41	90,798	0.00	0.13	0.03
Bonds	404	643,504	0.00	0.04	0.01

Table XII. Predictability of next-day price changes for index-related exchange-traded securities
Dependent variable: next-day returns

This table examines the extent to which predictable changes in market indices are captured in current and next-day pricing of index securities, world equity closed-end funds, WEBS, and ADRs. Next-day price changes are not predictable from the predicted index change for the S&P Mid-cap index security or for Asia-Pacific WEBS or ADRs. Changes in indices (the S&P Mid 400 or the country-specific MSCI index) are predicted using current day changes in the own index and the S&P 500, Russell 2000, MSCI Europe, Asia-Pacific Ex. Japan, Japan, and Latin America indices. The predictive model is estimated using pre-98 data and then applied out-of-sample to 1998-99. Standard errors are heteroskedasticity-robust and adjusting for clustering within trading days.

	N	R ²	Pred(Index, t+1)		Error(Index, t+1)		S&P 500 (t+1)	
			Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
S&P Mid-cap 400 future	2,590	0.76	0.17	0.20	0.94	0.03	0.10	0.03
Russell 2000 future	2,015	0.89	0.12	0.10	0.99	0.03	0.13	0.02
Nikkei future	2,584	0.53	0.37	0.08	0.51	0.03	0.56	0.04
Mexico IPC future	2,003	0.63	0.52	0.10	0.63	0.05	0.11	0.06
S&P Mid-cap 400 Spider	1,059	0.88	-0.04	0.14	1.00	0.02	0.12	0.02
All World Equity Funds	84,426	0.27	0.39	0.07	0.51	0.02	0.60	0.04
Western hemisphere WEFs	14,217	0.29	1.00	0.13	0.69	0.03	0.29	0.04
European WEFs	32,638	0.24	0.43	0.07	0.45	0.02	0.55	0.04
Asia-Pacific WEFs	37,571	0.28	0.32	0.08	0.50	0.02	0.71	0.05
All WEBS	13,144	0.53	0.22	0.11	0.80	0.03	0.40	0.03
North American WEBS	1,642	0.63	1.46	0.19	0.86	0.03	0.14	0.05
European WEBS	7,915	0.54	0.41	0.07	0.83	0.02	0.32	0.03
Asia-Pacific WEBS	3,587	0.51	-0.05	0.17	0.79	0.05	0.68	0.06
All ADRs	291,671	0.08	0.26	0.07	0.48	0.02	0.46	0.02
Western hemisphere ADRs	62,542	0.21	0.96	0.12	0.66	0.02	0.27	0.03
European ADRs	119,033	0.05	0.38	0.06	0.49	0.02	0.42	0.02
Asia-Pacific ADRs	67,169	0.08	0.04	0.11	0.45	0.03	0.54	0.05

Table XIII. Trading profits and liquidity of index securities, closed-end funds, and ADRs
Basis points

The absence of trading profits for the S&P Mid-cap 400 index security may be related to its higher daily trading volume, lower bid-ask spreads, and larger average trade size (which suggests more institutional ownership). For closed-end funds, WEBs, and ADRs, trading profits appear bounded by the roundtrip bid-ask spread, consistent with weak-form market efficiency. Roundtrip trading profit is an out-of-sample estimate of the profit from making four roundtrip trades per year in 1998-99 based on a predictive model estimated using pre-98 data. Bid-ask spreads, trading volume, size, and average share price are calculated from TAQ data for the month of September 1999 (a month with roughly average S&P 500 return and volatility). Bid-ask spreads shown are medians; other variables are means. The effective bid-ask spread is measured as the median of twice the absolute value of the difference between the trading price and the bid-ask average for the most recent quote. Quoted bid-ask spreads for index futures were recorded on 2/29/00.

	Roundtrip trading profit (Basis points)	Roundtrip bid-ask spread (basis points)	Quoted	Effective	Daily trading volume (Shares, 000s)	Average trade size (\$, 000s)	Average share price (\$)
S&P Mid-cap 400 future	-6	33	33		Not available		
Russell 2000 future	5	35	35		Not available		
Nikkei future	49	30	30		Not available		
Mexico IPC future	60	143	143		Not available		
S&P Mid-cap 400 Spider	-6	27	27	23	400	360	74
All World Equity Funds	83	141	141	74	84	17	11
Western hemisphere WEFs	94	136	136	77	69	14	12
European WEFs	78	154	154	74	33	14	13
Asia-pacific WEFs	78	139	139	74	113	19	10
All WEBs	69	126	126	93	80	29	17
North American WEBs	145	141	141	94	29	22	13
European WEBs	79	124	124	101	21	32	20
Asia-pacific WEBs	6	122	122	74	250	27	11
All ADRs	78	128	128	76	22	18	20
Western hemisphere ADRs	112	170	170	86	30	28	15
European ADRs	74	110	110	67	19	34	27
Asia-pacific ADRs	55	129	129	83	17	29	20

Table XIV. Determinants of short-term trading fee adoption

The use and size of short-term trading fees for funds at the seven largest no-load fund families are modeled as a function of the predictability and volatility of returns and fund family effects. The profit reduction from short-term fees is defined as the percentage reduction in the trading profit for a fund yielding four percent excess returns with four roundtrips per year. Specifically, the formula is: $\text{Min}(\text{Fee}, 1 - (\text{Days}/365))$, where Fee is the trading fee in percent and Days is the definition of short-term trading. Purchase fees, which are paid into the fund and thus not considered loads, are included in this analysis as short-term trading fees with an infinite time limit. Family effects are estimated relative to American Century; no family effect is estimated for Janus since no Janus funds have short-term fees. The hypothesis that predictability and volatility affect the incidence of fees equally can be rejected (in family-specific tests, it can be rejected for Dreyfus and Fidelity); for funds with the same trading strategy profitability, fees are higher and more common in the one with more predictable returns, which is also likely to have less liquid underlying assets and thus higher trading costs.

Specification Dep. Variable	Probit			Tobit		
	Coeff.	S.E.	Fund has fee?	Coeff.	S.E.	Profit reduction from fees
Ln(r)	0.95	0.15	1.20	0.75	0.17	0.79
Ln(Volatility)	0.45	0.09	0.59	0.46	0.11	0.45
Dreyfus			1.97			0.54
Fidelity			1.45			0.40
Scudder			0.52			0.42
T. Rowe Price			0.86			0.76
Vanguard			1.23			0.99
P-value of hypothesis tests						
Ln(r) = Ln(Vol.)	0.001		0.000	0.082		0.036
Family effects			0.000			0.017

Table A1. NAV volatility, serial correlation, S&P predictability, and contribution to predictive model from best other index.

	Funds	Obs	Std. Dev. (dNAV)	1-day lag dNAV Coeff.	1-day lag dNAV S.E.	2-day lag dNAV Coeff.	2-day lag dNAV S.E.	1-day lag S&P 500 Coeff.	1-day lag S&P 500 S.E.	S&P only Adjusted R-sq.	With best index Adjusted R-sq.	Best index
International equity	1,146	851,853	1.2	0.14	0.02	0.00	0.03	0.33	0.03	0.097	0.108	MSCI Emerging Market
Diversified Emerging Market	127	86,096	1.2	0.29	0.04	0.05	0.05	0.35	0.04	0.109	0.158	MSCI Emerging Market
Diversified Pacific/Asia	42	36,099	1.2	0.15	0.03	-0.01	0.03	0.42	0.04	0.193	0.193	MSCI Emerging Market
Europe Stock	92	64,840	1.2	0.08	0.03	-0.01	0.03	0.32	0.03	0.096	0.102	MSCI Latin America
Foreign Stock	518	382,514	1.0	0.11	0.03	-0.02	0.03	0.33	0.03	0.134	0.144	MSCI Latin America
Japan Stock	32	26,321	1.4	0.10	0.03	-0.01	0.03	0.34	0.03	0.089	0.089	MSCI Europe
Latin America Stock	34	26,060	1.9	0.14	0.06	0.02	0.06	0.19	0.08	0.012	0.033	MSCI Latin America
Pacific / Asia ex-Japan Stock	82	62,245	1.6	0.19	0.05	0.02	0.04	0.47	0.05	0.112	0.145	MSCI Emerging Market
World Stock	219	167,678	1.1	0.11	0.03	0.00	0.03	0.24	0.03	0.061	0.064	MSCI Emerging Market
Small Cap U.S. Equities	672	475,163	1.2	0.15	0.04	0.03	0.04	0.15	0.04	0.019	0.030	Russell 2000
Small Blend	189	128,887	1.1	0.14	0.04	0.04	0.04	0.13	0.04	0.017	0.033	Russell 2000
Small Growth	307	223,359	1.5	0.15	0.04	0.01	0.04	0.20	0.05	0.023	0.035	NASDAQ composite
Small Value	176	122,917	1.0	0.13	0.04	0.06	0.04	0.10	0.03	0.015	0.035	Russell 2000
Mid Cap U.S. Equities	706	596,642	1.3	0.09	0.03	0.00	0.03	0.13	0.04	0.012	0.014	Russell 2000
Mid Blend	198	164,295	1.2	0.07	0.03	0.01	0.03	0.11	0.04	0.011	0.013	Russell 2000
Mid Growth	309	265,985	1.5	0.10	0.03	-0.01	0.03	0.17	0.05	0.016	0.016	S&P 500
Mid Value	199	166,362	1.1	0.07	0.03	0.03	0.03	0.08	0.03	0.008	0.012	Russell 2000
Large Cap U.S. Equities	1,761	1,390,863	1.2	0.03	0.03	0.00	0.03	0.06	0.04	0.001	0.002	MSCI Europe
Large Blend	741	555,610	1.2	0.02	0.04	0.00	0.03	0.05	0.04	0.001	0.002	MSCI Europe
Large Growth	522	417,138	1.4	0.05	0.04	0.00	0.03	0.08	0.05	0.004	0.004	MSCI Europe
Large Value	498	418,115	1.1	0.02	0.03	0.01	0.03	0.04	0.03	0.001	0.001	MSCI Europe
Specialty U.S. equity funds	446	416,745	1.3	0.12	0.02	0.01	0.02	0.09	0.03	0.006	0.008	Philadelphia Gold & Silver
Specialty - Communications	18	19,579	1.3	0.09	0.03	0.03	0.03	0.15	0.04	0.009	0.011	MSCI Europe
Specialty - Financial	48	45,261	1.2	0.10	0.04	0.04	0.04	0.12	0.04	0.005	0.011	MSCI Emerging Market
Specialty - Health	50	45,129	1.3	0.09	0.03	0.01	0.03	0.13	0.04	0.012	0.016	NASDAQ composite
Specialty - Natural Resource	53	56,751	1.2	0.14	0.03	0.03	0.03	0.10	0.04	0.009	0.014	Philadelphia Gold & Silver
Specialty - Precious Metals	36	57,970	1.6	0.17	0.03	-0.02	0.02	0.07	0.05	0.002	0.044	Philadelphia Gold & Silver
Specialty - Real Estate	84	56,701	0.8	0.25	0.03	0.01	0.05	0.10	0.02	0.021	0.055	Russell 2000
Specialty - Technology	73	57,014	1.9	0.10	0.03	0.00	0.04	0.17	0.06	0.010	0.014	NASDAQ composite
Specialty - Utilities	84	78,340	0.8	0.02	0.02	0.02	0.02	-0.01	0.02	0.000	0.004	Dow Jones Utilities
High yield corporate bonds	250	187,346	0.3	0.20	0.03	0.17	0.02	0.05	0.01	0.045	0.065	Russell 2000
Corporate Bonds (Investment Grade)	757	573,334	0.3	0.04	0.02	0.03	0.02	0.01	0.01	0.003	0.010	10-year Treasury
Long - Term Bond	98	75,327	0.4	0.06	0.03	0.03	0.02	0.02	0.01	0.005	0.010	10-year Treasury
Interm. - Term Bond	440	327,295	0.3	0.04	0.02	0.03	0.02	0.02	0.01	0.004	0.012	10-year Treasury
Short - Term Bond	183	145,571	0.2	0.01	0.02	0.02	0.02	0.01	0.00	0.002	0.009	10-year Treasury
Ultrashort Bond	36	25,141	0.1	-0.05	0.01	0.00	0.01	0.00	0.00	0.000	0.001	10-year Treasury
Government Bonds	462	393,168	0.3	0.03	0.02	0.02	0.02	0.01	0.01	0.001	0.007	10-year Treasury
Long Government	46	47,963	0.6	0.04	0.02	0.02	0.02	0.02	0.01	0.001	0.003	10-year Treasury
Intermediate Government	273	228,905	0.3	0.04	0.03	0.02	0.02	0.01	0.01	0.002	0.011	10-year Treasury
Short Government	143	116,300	0.2	-0.07	0.05	0.01	0.02	0.01	0.00	0.001	0.008	10-year Treasury
Municipal Bonds	1,679	1,149,281	0.2	0.07	0.03	0.09	0.02	0.01	0.00	0.003	0.025	10-year Treasury
Muni National Long	260	222,220	0.2	0.03	0.05	0.09	0.02	0.01	0.00	0.004	0.023	10-year Treasury
Muni Single State Long	600	418,806	0.2	0.11	0.04	0.10	0.03	0.01	0.00	0.003	0.027	10-year Treasury
Muni California Long	99	73,163	0.2	0.14	0.02	0.01	0.09	0.01	0.00	0.004	0.029	10-year Treasury
Muni New York Long	78	59,155	0.2	0.07	0.06	0.09	0.03	0.01	0.00	0.003	0.026	10-year Treasury
Muni National Interm	265	123,681	0.2	0.00	0.07	0.09	0.02	0.01	0.00	0.002	0.024	10-year Treasury
Muni Single State Interm	224	154,147	0.2	0.06	0.05	0.11	0.02	0.01	0.00	0.002	0.027	10-year Treasury
Muni California Interm	35	24,139	0.2	0.14	0.03	0.10	0.03	0.01	0.01	0.003	0.025	10-year Treasury
Muni New York Interm	32	22,899	0.2	0.14	0.02	0.10	0.03	0.01	0.00	0.004	0.028	10-year Treasury
Muni Short	86	69,731	0.1	0.01	0.02	0.06	0.02	0.00	0.00	0.002	0.023	10-year Treasury
Other funds												
Convertible	48	44,170	0.8	0.07	0.07	0.02	0.03	0.15	0.02	0.044	0.048	Russell 2000
Domestic Hybrid	606	456,518	0.8	0.04	0.02	0.01	0.02	0.05	0.02	0.004	0.006	MSCI Emerging Market
Emerging Market Bond	28	21,620	1.2	0.14	0.05	0.00	0.05	0.09	0.04	0.008	0.031	MSCI Latin America
International Hybrid	61	48,378	0.8	0.03	0.00	0.00	0.02	0.14	0.11	0.035	0.037	MSCI Emerging Market
International Bond	145	123,162	0.5	-0.02	0.04	0.01	0.01	0.01	0.01	0.000	0.024	10-year Treasury
Multisector Bond	106	79,092	0.3	0.15	0.03	0.10	0.03	0.04	0.01	0.022	0.028	10-year Treasury

Table A2 Regression model predicting one-day NAV changes

	SD(pred)	R-sq	Prob(F)	2-day lagged dNAVs										MSCI Indices			
				Own fund	Category	S&P 500	10-year	Russell 2000	Europe	Asia ex Japan	Japan	Lat. Am					
International equity	0.40	0.114	0.00	-0.006 (0.005)	0.008 (0.035)	0.205 (0.050)	0.018 (0.033)	0.051 (0.062)	0.050 (0.039)	-0.008 (0.033)	-0.029 (0.020)	0.074 (0.024)					
Diversified Emerging Market	0.50	0.163	0.00	0.002 (0.011)	0.021 (0.056)	0.170 (0.067)	0.043 (0.044)	0.015 (0.078)	0.065 (0.053)	0.011 (0.048)	-0.005 (0.027)	0.156 (0.032)					
Diversified Pacific/Asia	0.55	0.199	0.00	-0.034 (0.017)	0.039 (0.038)	0.279 (0.051)	0.020 (0.034)	0.057 (0.063)	0.131 (0.060)	0.054 (0.044)	-0.017 (0.024)	0.079 (0.026)					
Europe Stock	0.40	0.112	0.00	0.009 (0.014)	-0.026 (0.049)	0.228 (0.061)	0.012 (0.039)	0.078 (0.082)	0.016 (0.044)	-0.044 (0.032)	-0.047 (0.024)	0.057 (0.025)					
Foreign Stock	0.41	0.151	0.00	-0.008 (0.007)	-0.001 (0.045)	0.221 (0.053)	0.016 (0.035)	0.085 (0.067)	0.057 (0.040)	-0.029 (0.031)	-0.037 (0.021)	0.059 (0.024)					
Japan Stock	0.43	0.092	0.00	-0.009 (0.021)	0.029 (0.040)	0.210 (0.068)	0.001 (0.043)	0.030 (0.089)	0.189 (0.085)	-0.029 (0.046)	0.005 (0.026)	0.054 (0.030)					
Latin America Stock	0.36	0.034	0.19	-0.006 (0.022)	0.021 (0.075)	0.053 (0.115)	-0.013 (0.082)	-0.083 (0.132)	0.054 (0.098)	-0.070 (0.075)	0.022 (0.052)	0.186 (0.065)					
Pacific / Asia ex-Japan Stock	0.62	0.145	0.00	-0.001 (0.019)	0.009 (0.039)	0.340 (0.070)	0.039 (0.046)	-0.005 (0.078)	0.087 (0.082)	0.140 (0.070)	-0.007 (0.037)	0.094 (0.038)					
World Stock	0.29	0.071	0.00	-0.006 (0.010)	0.017 (0.058)	0.130 (0.052)	0.010 (0.035)	0.078 (0.061)	0.046 (0.038)	-0.015 (0.033)	-0.041 (0.021)	0.043 (0.024)					
Small Cap U.S. Equities	0.24	0.036	0.02	-0.005 (0.009)	0.035 (0.058)	0.006 (0.073)	0.004 (0.047)	0.240 (0.084)	-0.089 (0.058)	0.019 (0.039)	-0.032 (0.030)	0.019 (0.034)					
Small Blend	0.23	0.042	0.01	-0.009 (0.008)	0.066 (0.065)	-0.028 (0.067)	0.036 (0.044)	0.245 (0.078)	-0.083 (0.053)	0.008 (0.036)	-0.028 (0.029)	0.016 (0.031)					
Small Growth	0.28	0.036	0.06	-0.005 (0.012)	0.004 (0.058)	0.032 (0.092)	0.001 (0.058)	0.242 (0.105)	-0.097 (0.074)	0.037 (0.050)	-0.022 (0.035)	0.022 (0.041)					
Small Value	0.21	0.047	0.00	-0.017 (0.010)	0.128 (0.064)	-0.040 (0.055)	0.010 (0.036)	0.224 (0.063)	-0.077 (0.042)	-0.006 (0.029)	-0.019 (0.024)	0.015 (0.025)					
Mid Cap U.S. Equities	0.16	0.014	0.06	-0.014 (0.007)	0.006 (0.056)	0.011 (0.070)	-0.002 (0.047)	0.109 (0.081)	-0.014 (0.057)	0.023 (0.039)	-0.039 (0.028)	0.026 (0.034)					
Mid Blend	0.15	0.015	0.05	-0.015 (0.007)	0.019 (0.063)	-0.005 (0.064)	-0.003 (0.044)	0.115 (0.073)	-0.005 (0.051)	0.014 (0.036)	-0.035 (0.026)	0.023 (0.031)					
Mid Growth	0.20	0.017	0.12	-0.018 (0.009)	-0.006 (0.058)	0.059 (0.091)	-0.012 (0.059)	0.104 (0.103)	-0.032 (0.074)	0.040 (0.050)	-0.046 (0.034)	0.026 (0.042)					
Mid Value	0.13	0.014	0.14	-0.006 (0.006)	0.053 (0.061)	-0.044 (0.055)	0.013 (0.038)	0.120 (0.063)	0.007 (0.044)	-0.006 (0.033)	-0.030 (0.022)	0.022 (0.027)					
Large Cap U.S. Equities	0.10	0.006	0.09	-0.013 (0.008)	-0.001 (0.051)	-0.021 (0.068)	-0.018 (0.045)	0.041 (0.077)	-0.018 (0.056)	0.011 (0.039)	-0.034 (0.027)	0.015 (0.034)					
Large Blend	0.10	0.007	0.51	-0.007 (0.012)	-0.012 (0.050)	-0.028 (0.064)	-0.019 (0.044)	0.043 (0.074)	0.078 (0.054)	0.012 (0.039)	-0.038 (0.026)	0.014 (0.034)					
Large Growth	0.12	0.006	0.16	-0.017 (0.009)	0.001 (0.055)	0.026 (0.083)	-0.025 (0.055)	0.003 (0.097)	0.079 (0.070)	0.013 (0.049)	-0.040 (0.033)	0.013 (0.041)					
Large Value	0.09	0.007	0.02	-0.015 (0.005)	0.013 (0.054)	-0.057 (0.055)	-0.011 (0.039)	0.075 (0.064)	0.052 (0.047)	0.008 (0.034)	-0.026 (0.023)	0.018 (0.029)					
Specialty U.S. equity funds	0.13	0.009	0.07	-0.012 (0.008)	0.014 (0.030)	-0.042 (0.050)	-0.022 (0.033)	0.108 (0.058)	0.023 (0.043)	0.012 (0.029)	-0.031 (0.021)	0.027 (0.025)					
Specialty - Communications	0.17	0.016	0.14	0.003 (0.020)	0.018 (0.059)	-0.001 (0.073)	-0.030 (0.044)	0.111 (0.085)	0.051 (0.062)	-0.015 (0.045)	-0.031 (0.029)	0.029 (0.036)					
Specialty - Financial	0.16	0.014	0.72	0.002 (0.017)	0.032 (0.055)	-0.038 (0.084)	-0.002 (0.051)	0.114 (0.103)	0.032 (0.072)	-0.004 (0.050)	-0.030 (0.033)	0.035 (0.039)					
Specialty - Health	0.14	0.011	0.32	0.016 (0.011)	-0.039 (0.058)	0.003 (0.076)	-0.011 (0.047)	0.135 (0.086)	0.002 (0.065)	0.006 (0.048)	-0.038 (0.029)	-0.008 (0.033)					
Specialty - Natural Resource	0.16	0.014	0.12	-0.025 (0.018)	0.048 (0.038)	-0.085 (0.064)	0.026 (0.043)	0.142 (0.070)	0.008 (0.054)	0.033 (0.037)	-0.025 (0.029)	0.032 (0.031)					
Specialty - Precious Metals	0.23	0.017	0.00	-0.054 (0.013)	0.009 (0.034)	-0.155 (0.088)	-0.119 (0.058)	0.104 (0.103)	0.169 (0.078)	0.019 (0.050)	-0.025 (0.043)	0.038 (0.039)					
Specialty - Real Estate	0.24	0.088	0.00	0.000 (0.009)	0.185 (0.060)	-0.055 (0.048)	0.022 (0.032)	0.220 (0.059)	-0.081 (0.041)	-0.014 (0.024)	-0.028 (0.022)	0.030 (0.022)					
Specialty - Technology	0.19	0.009	0.59	-0.016 (0.016)	0.001 (0.051)	0.091 (0.120)	-0.032 (0.074)	0.001 (0.137)	0.023 (0.100)	0.042 (0.074)	-0.057 (0.045)	0.036 (0.054)					
Specialty - Utilities	0.08	0.006	0.32	-0.001 (0.012)	0.017 (0.046)	-0.077 (0.035)	-0.043 (0.029)	0.040 (0.042)	0.041 (0.031)	-0.005 (0.022)	-0.024 (0.015)	0.022 (0.019)					
High-yield corporate bonds	0.11	0.151	0.00	0.002 (0.007)	0.456 (0.045)	0.005 (0.010)	-0.007 (0.007)	0.013 (0.013)	0.007 (0.007)	-0.009 (0.005)	-0.005 (0.005)	0.016 (0.009)					
Corporate Bonds (Investment Grade)	0.03	0.012	0.03	-0.007 (0.006)	0.042 (0.031)	0.007 (0.011)	-0.021 (0.008)	0.007 (0.013)	-0.002 (0.009)	0.001 (0.005)	-0.005 (0.005)	0.000 (0.005)					
Long - Term Bond	0.04	0.014	0.22	-0.008 (0.019)	0.044 (0.034)	0.013 (0.017)	-0.025 (0.013)	0.013 (0.022)	-0.004 (0.014)	0.003 (0.009)	-0.010 (0.009)	0.002 (0.008)					
Intermediate - Term Bond	0.04	0.014	0.02	-0.005 (0.005)	0.037 (0.032)	0.009 (0.012)	-0.026 (0.010)	0.008 (0.016)	-0.003 (0.011)	0.002 (0.007)	-0.007 (0.006)	0.000 (0.006)					
Short - Term Bond	0.02	0.010	0.00	-0.013 (0.009)	0.044 (0.032)	0.003 (0.006)	-0.013 (0.005)	0.004 (0.007)	-0.001 (0.005)	0.001 (0.003)	-0.001 (0.003)	0.000 (0.003)					
Ultrashort Bond	0.00	0.002	0.06	-0.008 (0.006)	0.052 (0.036)	0.002 (0.002)	-0.003 (0.002)	-0.001 (0.001)	-0.001 (0.001)	0.001 (0.001)	-0.001 (0.001)	0.001 (0.001)					
Government Bonds	0.03	0.010	0.08	0.004 (0.011)	0.018 (0.023)	0.008 (0.010)	-0.021 (0.008)	0.003 (0.013)	-0.002 (0.009)	0.000 (0.005)	-0.008 (0.005)	-0.001 (0.005)					
Long Government	0.05	0.008	0.38	0.012 (0.017)	0.014 (0.019)	0.020 (0.023)	-0.028 (0.017)	0.007 (0.030)	-0.012 (0.020)	-0.001 (0.014)	-0.014 (0.012)	-0.004 (0.011)					
Intermediate Government	0.03	0.014	0.02	-0.003 (0.009)	0.015 (0.028)	0.011 (0.011)	-0.024 (0.008)	0.001 (0.013)	-0.001 (0.009)	0.001 (0.005)	-0.008 (0.006)	0.000 (0.005)					
Short Government	0.02	0.009	0.06	-0.001 (0.008)	0.021 (0.032)	0.004 (0.006)	-0.014 (0.005)	0.002 (0.007)	0.000 (0.005)	0.000 (0.003)	-0.002 (0.003)	-0.001 (0.003)					
Municipal Bonds	0.04	0.040	0.00	-0.006 (0.004)	0.146 (0.035)	0.013 (0.007)	-0.024 (0.008)	-0.003 (0.009)	0.000 (0.006)	-0.001 (0.004)	-0.003 (0.003)	-0.004 (0.003)					
Muni National Long	0.04	0.040	0.00	-0.008 (0.006)	0.139 (0.037)	0.016 (0.009)	0.028 (0.007)	-0.004 (0.012)	0.000 (0.008)	-0.001 (0.005)	-0.004 (0.004)	-0.005 (0.004)					
Muni Single State Long	0.04	0.043	0.00	-0.009 (0.005)	0.145 (0.038)	0.014 (0.008)	-0.025 (0.006)	-0.003 (0.010)	0.000 (0.007)	-0.001 (0.005)	-0.003 (0.003)	-0.005 (0.003)					
Muni California Long	0.04	0.047	0.00	-0.009 (0.011)	0.147 (0.036)	0.018 (0.008)	-0.029 (0.007)	-0.005 (0.011)	0.000 (0.007)	-0.001 (0.005)	-0.004 (0.004)	-0.005 (0.004)					
Muni New York Long	0.04	0.036	0.00	-0.004 (0.004)	0.139 (0.035)	0.015 (0.008)	-0.027 (0.006)	-0.003 (0.010)	0.000 (0.007)	-0.001 (0.005)	-0.003 (0.004)	-0.005 (0.004)					
Muni National Interm	0.03	0.045	0.00	-0.025 (0.009)	0.168 (0.039)	0.015 (0.007)	-0.021 (0.005)	-0.006 (0.009)	0.002 (0.006)	-0.001 (0.004)	-0.003 (0.003)	-0.004 (0.003)					
Muni Single State Interm	0.03	0.046	0.00	0.002 (0.006)	0.158 (0.036)	0.011 (0.007)	-0.021 (0.005)	-0.002 (0.008)	0.000 (0.005)	0.000 (0.004)	-0.003 (0.003)	-0.004 (0.003)					
Muni California Interm	0.03	0.040	0.00	0.009 (0.034)	0.133 (0.052)	0.012 (0.007)	-0.022 (0.006)	-0.003 (0.009)	-0.001 (0.006)	-0.002 (0.004)	-0.002 (0.003)	-0.003 (0.003)					
Muni New York Interm	0.03	0.040	0.00	-0.004 (0.004)	0.171 (0.036)	0.009 (0.008)	-0.021 (0.005)	0.000 (0.008)	-0.001 (0.005)	-0.001 (0.003)	-0.002 (0.003)	-0.004 (0.003)					
Muni Short	0.02	0.037	0.00	-0.024 (0.008)	0.185 (0.034)	0.006 (0.010)	-0.011 (0.007)	-0.001 (0.004)	-0.001 (0.002)	0.000 (0.002)	-0.001 (0.001)	-0.002 (0.001)					
Other funds																	
Convertibles	0.18	0.046	0.00	-0.009 (0.011)	0.040 (0.051)	0.085 (0.038)	0.006 (0.023)	0.081 (0.043)	-0.013 (0.030)	0.009 (0.020)	-0.025 (0.015)	0.007 (0.018)					
Domestic Hybrid	0.08	0.009	0.00	-0.012 (0.008)	0.039 (0.046)	0.004 (0.033)	-0.015 (0.023)	0.037 (0.038)	0.023 (0.027)	0.001 (0.020)	-0.022 (0.014)	0.012 (0.017)					
Emerging Market Bond	0.22	0.036	0.00	-0.050 (0.023)	0.051 (0.079)	-0.034 (0.064)	-0.020 (0.035)	0.006 (0.079)	0.042 (0.053)	-0.047 (0.047)	0.034 (0.024)	0.118 (0.034)					
International Hybrid	0.07	0.028	0.00	-0.001 (0.008)	0.018 (0.033)	-0.006 (0.013)	-0.071 (0.009)	-0.015 (0.017)	0.021 (0.011)	0.002 (0.007)	-0.002 (0.006)	0.007 (0.					

Table A3. Day-of-the-week effects from a regression of NAV changes on lagged changes and market indices

	Incremental explanatory power [Incr in SD(Pred)]	Joint test of significance (P-value)	Monday		Wednesday		Thursday		Friday	
			Coeff	S.E.	Coeff	S.E.	Coeff.	S.E.	Coeff	S.E.
International equity	0.01	0.42	-5.6	7.8	4.3	7.2	-10.7	7.6	7.8	7.4
Diversified Emerging Markets	0.01	0.19	-6.2	10.9	1.8	10.5	-19.2	10.7	16.1	10.2
Diversified Pacific/Asia	0.00	0.81	-7.7	9.2	8.2	9.4	-0.2	8.9	3.6	9.0
Europe Stock	0.00	0.74	0.4	9.1	4.3	8.4	-7.0	9.1	9.5	9.0
Foreign Stock	0.00	0.65	-5.5	8.0	1.4	7.5	-10.7	7.9	2.8	7.7
Japan Stock	0.00	0.58	-14.7	11.8	-0.3	12.5	-2.9	11.2	-12.2	10.9
Latin American Stock	0.06	0.04	-35.0	18.3	-8.1	18.4	-49.0	19.4	4.7	18.0
Pacific / Asia ex-Japan Stoc	0.01	0.12	3.0	13.1	16.5	12.1	0.3	11.7	27.5	11.8
World Stock	0.01	0.27	-3.5	7.9	9.6	7.2	-7.7	7.9	11.3	7.5
Small Cap U.S. Equities	0.02	0.06	0.4	10.8	21.3	10.0	-1.1	10.6	22.3	10.4
Small Blend	0.02	0.08	2.0	9.5	18.0	9.1	-1.1	9.6	19.5	9.4
Small Growth	0.03	0.06	-0.8	14.0	28.3	13.0	-0.3	13.2	27.0	13.2
Small Value	0.01	0.03	3.7	7.6	14.7	7.4	-0.3	8.1	19.2	7.6
Mid Cap U.S. Equities	0.03	0.13	0.4	11.3	20.4	10.0	-3.5	11.0	18.1	10.8
Mid-Cap Blend	0.03	0.16	0.7	10.0	16.4	9.0	-4.6	9.9	16.6	9.6
Mid-Cap Growth	0.04	0.09	-1.6	14.5	29.7	13.1	0.9	13.8	23.3	13.6
Mid-Cap Value	0.02	0.18	5.8	9.0	14.0	8.0	-5.4	8.9	13.8	8.9
Large Cap U.S. Equities	0.04	0.26	6.2	11.6	14.9	10.5	-8.6	11.5	17.6	11.3
Large Blend	0.04	0.29	6.4	11.4	13.3	10.4	-9.6	11.4	17.0	11.3
Large Growth	0.04	0.30	3.7	14.1	19.8	13.0	-8.2	13.9	19.9	13.6
Large Value	0.03	0.20	8.6	9.9	12.1	8.8	-7.6	9.8	16.2	9.8
Specialty U.S. equity funds	0.03	0.03	-0.9	9.0	16.8	7.8	2.0	8.2	20.3	8.2
Specialty - Communications	0.03	0.03	9.0	11.8	22.5	11.1	2.1	11.8	27.0	10.8
Specialty - Financial	0.04	0.38	-4.6	13.5	9.2	12.4	-9.0	13.6	23.6	13.4
Specialty - Health	0.03	0.38	-6.6	13.0	16.5	12.0	-0.7	11.9	17.3	12.2
Specialty - Natural Resource	0.06	0.00	2.1	11.7	37.8	11.5	19.1	10.6	32.2	10.7
Specialty - Precious Metals	0.05	0.16	-17.7	16.8	11.2	14.0	27.2	14.2	14.7	14.2
Specialty - Real Estate	0.02	0.07	-0.9	6.8	1.3	6.4	-9.0	6.9	19.7	7.6
Specialty - Technology	0.07	0.09	11.1	21.2	43.8	19.5	1.3	20.0	31.9	19.4
Specialty - Utilities	0.01	0.19	5.9	7.1	8.9	6.2	-0.9	6.9	12.1	6.6
High Yield Bond	0.00	0.08	-0.9	1.1	-1.1	1.1	-4.1	1.6	0.0	1.2
Corporate Bonds (Investment Grad.	0.00	0.49	-3.4	1.9	-0.7	1.8	0.7	2.1	0.2	2.3
Interm - Term Bond	0.00	0.45	-4.2	2.2	-0.7	2.1	0.6	2.4	0.1	2.7
Long - Term Bond	0.01	0.72	-4.0	3.0	-1.2	2.9	1.2	3.2	0.2	3.5
Short - Term Bond	0.00	0.29	-2.1	1.1	0.0	1.1	1.1	1.2	0.4	1.3
Ultrasort Bond	0.00	0.04	0.6	0.4	0.5	0.4	0.7	0.4	0.8	0.5
Government Bonds	0.00	0.38	-3.8	1.9	-0.3	1.9	0.9	2.1	0.5	2.3
Intermediate Government	-0.02	0.28	-4.4	2.0	-0.6	2.0	1.0	2.2	0.6	2.4
Long Government	0.03	0.74	-5.5	4.1	-1.2	4.0	0.8	4.4	1.2	4.9
Short Government	0.00	0.18	-2.4	1.1	0.2	1.0	1.0	1.1	0.5	1.3
Municipal Bonds	0.00	0.40	-2.2	1.3	0.1	1.3	0.8	1.5	1.5	1.7
Muni California Interm	-0.01	0.47	-2.2	1.3	0.3	1.3	0.4	1.4	1.2	1.7
Muni California Long	0.01	0.38	-3.0	1.6	0.1	1.6	0.6	1.8	1.6	2.1
Muni National Interm	-0.01	0.47	-1.8	1.0	0.3	1.1	0.4	1.2	0.9	1.4
Muni National Long	0.00	0.45	-2.6	1.5	0.0	1.5	0.7	1.7	1.3	1.9
Muni New York Interm	0.00	0.28	-2.4	1.2	-0.2	1.2	0.6	1.4	1.6	1.6
Muni New York Long	0.01	0.38	-2.8	1.6	0.1	1.7	1.2	1.9	1.8	2.1
Muni Short	-0.02	0.17	-1.0	0.5	0.2	0.5	0.3	0.6	0.8	0.6
Muni Single State Interm	0.00	0.33	-2.0	1.1	0.6	1.2	0.9	1.3	1.1	1.5
Muni Single State Long	0.02	0.38	-2.4	1.4	0.5	1.5	1.2	1.6	1.6	1.8
Other funds	0.00									
Convertibles	0.01	0.15	2.1	6.3	11.0	5.9	-0.1	6.0	11.0	6.3
Domestic Hybrid	0.01	0.28	3.1	6.0	7.8	5.5	-3.4	6.0	9.5	6.1
Emerging Markets Bond	0.03	0.00	-18.8	8.5	-24.3	8.3	-33.4	9.7	-7.1	8.6
International Bond	0.01	0.00	-9.3	2.3	-5.6	2.2	-2.2	2.2	-6.9	2.4
International Hybnd	0.00	0.32	-4.7	3.4	1.4	3.5	-5.5	3.5	0.6	3.5
Multisector Bond	0.00	0.00	-5.6	1.6	-3.0	1.5	-4.2	1.8	-1.5	1.8

Table A4. Profitability of trading strategy involving four roundtrip trades per year

Methodology 1										Methodology 2										Methodology 3									
Estimated from standard deviation of predicted next-day NAV change										Estimated from returns immediately following buy and sell triggers										Excess returns from simulation of trading strategy									
	In-sample	Out-of-sample	1-day window		1-day window		1-day window		1-day window		1-day window		5-day window		Unadjusted		CAPM adjusted		Unadjusted		CAPM adjusted		Multi-factor						
			Coef	S.E	Coef	S.E	Coef	S.E	Coef	S.E	Coef	S.E	Coef	S.E	Coef	S.E	Coef	S.E	Coef	S.E	Coef	S.E	Coef	S.E					
International equity	7.2	7.1	8.5	1.4	8.6	1.2	7.7	0.7	7.0	0.7	4.6	12.2	4.5	11.8	3.8	10.7	2.2	3.8	10.7	2.2	3.8	10.7	2.2	3.8	10.7				
Diversified Emerging Markets	9.2	8.5	9.6	2.0	10.0	1.5	8.8	1.0	7.8	5.0	7.8	6.9	14.1	6.0	13.7	3.6	36	12.8	6.9	14.1	6.0	13.7	3.6	36	12.8				
Diversified Pacific/Asia	9.9	9.9	9.9	1.5	9.8	1.5	8.6	0.8	7.1	3.6	5.2	15.0	5.3	14.6	4.8	13.0	2.5	25	13.1	7.2	13.1	7.2	11.6	3.8	28	13.1			
Europe Stock	7.3	7.0	9.2	1.6	9.4	1.4	8.2	0.7	2.3	5.2	15.0	5.3	14.6	4.8	13.0	2.5	25	13.1	7.2	13.1	7.2	11.6	3.8	28	13.1				
Foreign Stock	7.4	7.1	8.4	1.4	8.6	1.3	7.7	0.6	2.2	4.7	11.6	4.7	11.3	4.3	11.0	2.6	26	12.9	4.7	11.3	4.3	11.0	2.6	26	12.9				
Japan Stock	7.8	8.3	6.9	1.9	6.9	1.9	7.2	0.8	7.5	4.5	13.1	7.2	13.1	7.2	11.6	3.8	28	13.1	7.2	13.1	7.2	11.6	3.8	28	13.1				
Latin American Stock	7.5	3.9	6.1	5.2	6.6	4.1	4.1	1.0	12.9	10.3	38.3	11.6	32.3	9.3	8.4	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8				
Pacific / Asia ex-Japan Stock	11.2	10.1	11.9	2.0	12.0	2.0	10.7	1.0	7.1	5.8	14.2	7.6	14.2	7.5	13.3	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1				
World Stock	5.5	4.9	5.8	1.2	6.0	0.8	5.9	0.6	2.1	3.8	13.2	4.8	11.5	3.2	9.2	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1				
Small Cap U.S. Equities	4.8	3.8	6.6	1.8	6.0	1.2	3.9	0.7	11.1	5.2	11.7	5.7	7.5	3.5	5.4	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9				
Small Blend	4.4	3.5	5.5	1.7	5.0	1.2	3.4	0.7	9.5	4.9	12.0	4.8	12.9	3.3	8.5	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8				
Small Growth	5.6	4.3	6.0	2.4	6.5	1.4	4.9	0.8	7.3	6.6	8.5	7.4	1.8	4.6	2.2	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9				
Small Value	4.0	3.3	5.3	1.7	4.3	1.1	3.3	0.7	11.0	4.3	13.9	4.0	15.2	3.0	12.1	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9				
Mid Cap U.S. Equities	3.4	1.7	4.0	1.8	3.4	0.9	2.4	0.7	6.0	5.6	6.2	2.4	4.3	1.7	4.3	1.7	4.3	1.7	4.3	1.7	4.3	1.7	4.3	1.7	4.3				
Mid-Cap Blend	3.1	1.4	3.0	1.5	2.7	0.8	1.9	0.5	1.5	4.4	8.7	4.8	8.1	2.1	5.9	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4				
Mid-Cap Growth	4.3	2.5	4.4	2.2	5.4	1.0	4.0	0.8	-0.3	6.6	6.1	5.2	3.0	4.4	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1				
Mid-Cap Value	2.7	0.8	1.2	1.4	1.1	0.6	1.2	0.5	4.6	3.7	6.6	4.4	6.2	2.0	4.6	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7				
Large Cap U.S. Equities	2.5	0.5	-0.9	1.2	0.4	0.2	0.3	0.1	-1.7	4.4	-8.8	6.0	-0.9	0.9	-1.5	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8				
Large Blend	2.5	0.5	-0.9	1.2	0.2	0.1	0.1	0.1	-2.3	4.2	-6.1	6.0	-0.7	0.8	-1.1	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7				
Large Growth	2.9	0.4	0.0	1.8	1.1	0.4	1.2	0.4	-2.0	5.6	-3.5	6.1	0.0	1.6	-0.6	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4				
Large Value	2.3	0.5	-0.8	1.2	-0.1	0.3	-0.2	0.3	-0.5	3.8	-1.3	5.0	-1.1	1.7	-1.5	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7				
Specialty U.S. equity funds	2.8	1.5	1.7	1.2	2.2	0.6	2.1	0.5	3.5	3.6	10.5	4.3	8.4	2.1	7.5	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7				
Specialty - Communications	3.7	1.9	3.3	1.9	2.7	1.1	1.5	0.8	0.7	5.4	2.6	7.3	2.6	3.3	-0.6	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0				
Specialty - Financial	3.5	1.0	2.3	2.6	0.9	1.3	1.1	1.2	4.8	8.0	2.6	7.9	1.5	3.8	-0.4	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8				
Specialty - Health	3.1	1.9	2.4	2.1	3.1	1.3	3.0	1.2	-4.3	5.4	2.9	6.7	4.2	3.7	3.4	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6				
Specialty - Natural Resource	3.9	1.9	2.2	1.6	2.1	1.2	2.1	1.1	4.6	6.2	6.8	4.7	6.2	3.3	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9				
Specialty - Precious Metals	4.9	1.1	1.6	2.9	1.3	2.8	1.5	2.8	3.9	8.0	5.1	9.3	5.2	9.2	5.8	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7				
Specialty - Real Estate	4.6	4.2	6.0	1.7	5.5	1.4	5.8	1.2	7.7	4.6	5.1	3.9	4.9	3.5	4.2	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1				
Specialty - Technology	4.7	0.9	1.5	3.2	4.1	1.5	2.1	1.2	-8.5	6.4	-10.4	7.9	-7.3	4.4	-3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9				
Specialty - Utilities	1.7	0.5	0.4	0.9	0.4	0.6	-0.2	0.6	-0.7	2.5	3.0	3.7	4.1	2.3	3.1	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3				
High Yield Bond	1.9	1.8	0.3	1.9	0.3	1.9	0.3	2.1	1.4	3.5	0.8	4.0	0.8	4.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9				
Corporate Bonds (Investment Grade)	0.6	0.3	0.3	0.3	0.3	0.3	0.2	0.3	1.3	0.6	2.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0				
Interim - Term Bond	0.7	0.4	0.2	0.4	0.2	0.4	0.2	0.4	1.2	0.7	2.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2				
Long - Term Bond	0.9	0.4	0.6	0.5	0.6	0.5	0.6	0.4	2.5	1.0	3.5	1.5	3.5	1.5	3.5	1.5	3.5	1.5	3.5	1.5	3.5	1.5	3.5	1.5	3.5				
Short - Term Bond	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	1.0	0.6	1.1	0.6	1.1	0.6	1.1	0.6	1.1	0.6	1.1	0.6	1.1	0.6	1.1				
Ultrashort Bond	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1				
Government Bonds	0.6	0.3	0.6	0.3	0.6	0.3	0.5	0.3	0.6	0.6	0.6	0.6	0.5	1.1	0.6	1.1	0.6	1.1	0.6	1.1	0.6	1.1	0.6	1.1	0.6				
Intermediate Government	0.7	0.4	0.3	0.3	0.3	0.3	0.2	0.3	0.5	0.6	0.7	1.2	0.8	1.2	0.8	1.2	0.8	1.2	0.8	1.2	0.8	1.2	0.8	1.2	0.8				
Long Government	1.0	0.5	0.8	0.6	0.9	0.6	0.8	0.6	0.3	1.6	1.3	2.3	1.3	2.3	1.3	2.3	1.3	2.3	1.3	2.3	1.3	2.3	1.3	2.3	1.3				
Short Government	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.3	0.6	0.3	0.6	0.3	0.6	0.3	0.6	0.3	0.6	0.3	0.6	0.3	0.6	0.3				
Municipal Bonds	0.7	0.5	0.4	0.1	0.4	0.1	0.4	0.1	1.1	0.7	1.1	0.7	1.1	0.7	1.1	0.7	1.1	0.7	1.1	0.7	1.1	0.7	1.1	0.7	1.1				
Muni California Intern	0.7	0.4	0.4	0.1	0.4	0.1	0.4	0.1	1.0	0.6	1.1	0.7	1.1	0.7	1.1	0.6	1.1	0.6	1.1	0.7	1.1	0.7	1.1	0.6	1.1				
Muni California Long	0.8	0.6	0.6	0.2	0.5	0.2	0.5	0.2	1.3	0.8	2.9	0.8	3.0	0.8	2.6	0.8	2.6	0.8	2.6	0.8	2.6	0.8	2.6	0.8	2.6				
Muni National Intern	0.6	0.5	0.1	0.5	0.1	0.5	0.1	0.5	0.1	0.9	0.5	1.8	0.6	1.8	0.6	1.5	0.6	1.5	0.6	1.8	0.6	1.5	0.6	1.5	0.6				
Muni National Long	0.8	0.6	0.5	0.2	0.5	0.2	0.5	0.2	1.5	0.8	2.3	0.8	2.4	0.8	2.0	0.8	2.0	0.8	2.4	0.8	2.0	0.8	2.0	0.8	2.0				
Muni New York Intern	0.7	0.4	0.1	0.4	0.1	0.4	0.1	0.4	1.2	0.7	0.8	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6				
Muni New York Long	0.8	0.6	0.5	0.2	0.5	0.2	0.5	0.2	1.1	0.8	1.8	0.9	1.8	0.9	1.4	0.9	1.4	0.9	1.8	0.9	1.4	0.9	1.4	0.9	1.4				
Muni Short	0.3	0.3	0.2	0.1	0.2	0.1	0.2	0.1	0.3	0.2	0.7	0.3	0.7	0.3	0.7	0.3	0.7	0.3	0.7	0.3	0.7	0.3	0.7	0.3	0.7				
Muni Single State Intern	0.6	0.4	0.5	0.1	0.5	0.1	0.5	0.1	0.9	0.5	2.1	0.6	2.2	0.6	1.9	0.6	1.9	0.6	2.2	0.6	1.9	0.6	1.9	0.6	1.9				
Muni Single State Long	0.7	0.5	0.4																										

Table A5. Predictability of daily fund returns from prior-day S&P 500 change by year

This table checks whether 1998 and 1999 were representative years for estimating the profitability of the trading strategy by comparing the standard deviation of predicted next-day fund returns and its components, return predictability (R) and volatility (SD(dNAV)), with prior years. Trading strategy profitability was about 25% higher for the 1998-99 period than the entire 1986-99 period for international funds, due mainly to lower predictability, but profitability for small-cap funds was slightly higher. Only the S&P 500 is used to predict returns since daily data for the other indices was not available back to 1986. Standard errors are heteroskedasticity robust and adjusted for clustering within trading days

	In-sample predictability			S&P 500 predictability		
	SD(pred)	R	SD(dNAV)	Coeff.	S.E.	Obs.
International equity funds						
1986	0.20	0.16	1.2	0.21	0.05	1,311
1987	0.62	0.26	2.4	0.29	0.06	2,437
1988	0.20	0.27	0.7	0.18	0.03	2,649
1989	0.27	0.10	2.6	0.32	0.11	3,185
1990	0.35	0.34	1.1	0.35	0.05	4,928
1991	0.25	0.27	0.9	0.28	0.06	6,301
1992	0.18	0.23	0.8	0.30	0.07	6,506
1993	0.12	0.17	0.7	0.22	0.06	9,198
1994	0.24	0.30	0.8	0.38	0.04	16,281
1995	0.22	0.09	2.3	0.44	0.06	20,908
1996	0.23	0.10	2.3	0.31	0.03	91,821
1997	0.44	0.30	1.5	0.38	0.04	184,071
1998	0.38	0.25	1.5	0.30	0.06	229,794
1999	0.37	0.34	1.1	0.33	0.04	272,496
1998-99 (weighted by num. of obs.)	0.38	0.29	1.3	0.31	0.03	502,290
1986-99 (unweighted)	0.29	0.23	1.4	0.31		
Emerging market equity funds						
1986	0.03	0.01	1.8	0.03	0.21	135
1987	0.90	0.40	2.2	0.42	0.07	502
1988	0.22	0.31	0.7	0.20	0.03	506
1989	0.16	0.19	0.8	0.20	0.11	504
1990	0.52	0.43	1.2	0.51	0.08	724
1991	0.34	0.37	0.9	0.38	0.07	758
1992	0.19	0.25	0.8	0.31	0.08	814
1993	0.15	0.20	0.8	0.30	0.09	1,619
1994	0.32	0.29	1.1	0.51	0.07	3,516
1995	0.30	0.06	4.6	0.60	0.09	4,772
1996	0.25	0.06	4.3	0.33	0.04	24,001
1997	0.51	0.26	2.0	0.45	0.05	47,418
1998	0.46	0.25	1.8	0.35	0.08	57,619
1999	0.44	0.33	1.3	0.38	0.05	67,622
1998-99 (weighted by num. of obs.)	0.45	0.29	1.6	0.37	0.04	125,241
1986-99 (unweighted)	0.34	0.24	1.7	0.36		
U.S. small-cap equity funds						
1986	0.20	0.17	1.2	0.22	0.04	1,518
1987	0.62	0.36	1.7	0.29	0.08	1,518
1988	0.14	0.02	7.9	0.12	0.04	1,518
1989	0.17	0.06	2.9	0.20	0.03	2,386
1990	0.28	0.31	0.9	0.27	0.06	3,342
1991	0.20	0.23	0.8	0.22	0.04	3,799
1992	0.15	0.18	0.8	0.24	0.07	5,478
1993	0.17	0.19	0.9	0.31	0.07	6,808
1994	0.15	0.17	0.9	0.25	0.08	7,877
1995	0.12	0.11	1.1	0.24	0.09	9,812
1996	0.16	0.04	3.9	0.22	0.08	45,743
1997	0.16	0.14	1.1	0.14	0.08	95,871
1998	0.19	0.12	1.6	0.15	0.09	129,898
1999	0.17	0.08	2.0	0.14	0.04	159,612
1998-99 (weighted by num. of obs.)	0.18	0.10	1.8	0.14	0.04	289,510
1986-99 (unweighted)	0.20	0.16	2.0	0.22		

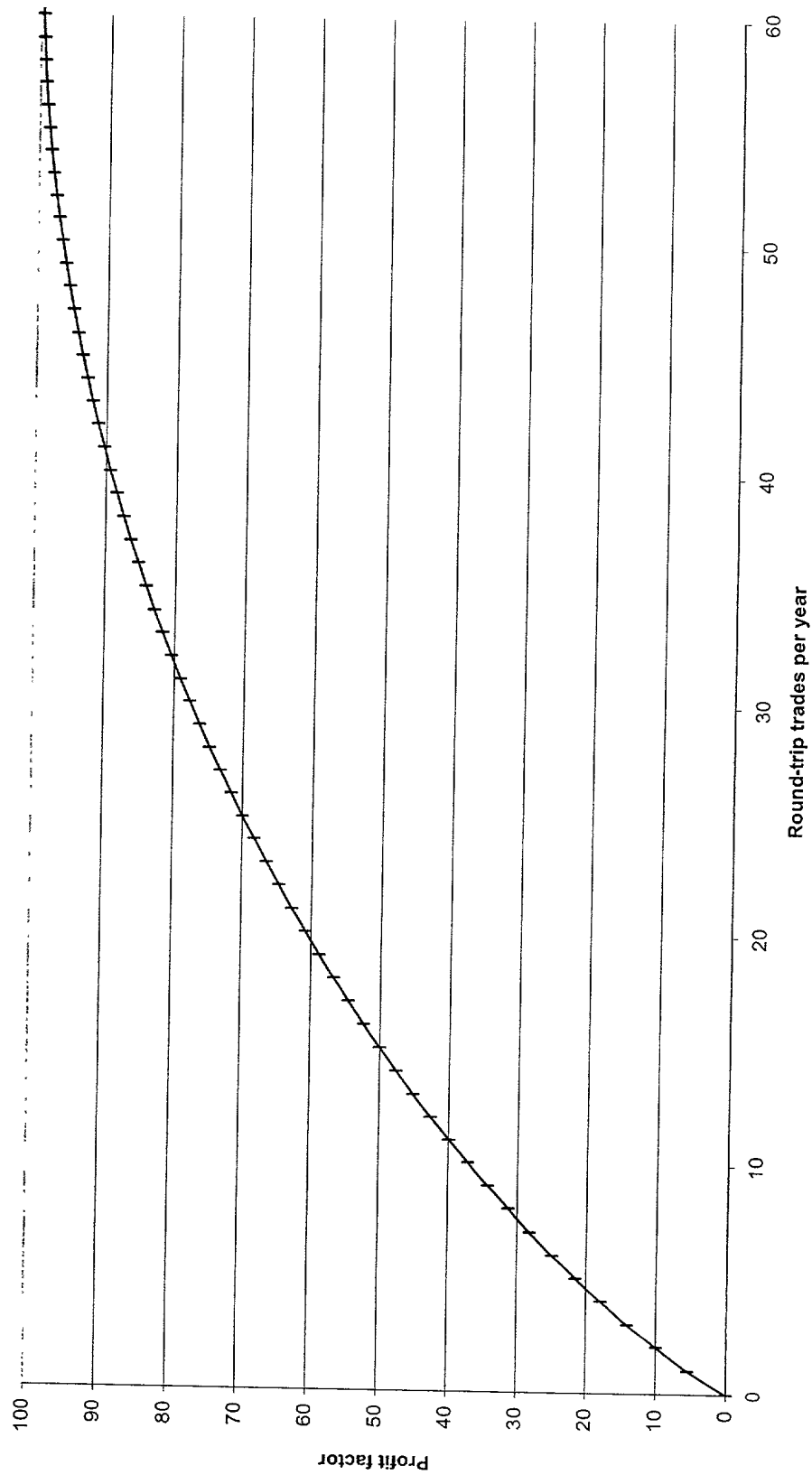
Table A6. Family predictability effects for families with thirty of more funds
Dependent variable: Log(*r*)

	Family effect	No. of funds	Load (% with load)	Total assets (\$ billions)
Primarily no-load families				
Scudder Funds	0.11	46	0	29
Warburg Pincus Funds	0.09	46	0	7
Janus	0.08	37	0	123
Price T. Rowe Funds	0.06	69	0	98
Strong Funds	0.05	40	0	22
Dreyfus Group	0.04	73	3	35
Vanguard Group	0.03	88	0	442
American Century Investments	0.02	92	1	77
UAM Funds	0.01	56	6	3
DFA Investment Dimensions Group	-0.03	31	0	14
Rydex Series Trust	-0.03	33	0	3
Fidelity Group	-0.05	145	45	501
GMO LLC	-0.15	39	0	15
Loomis Sayles Funds	-0.53	35	0	3
Primarily load-fund families				
Salomon Brothers Group	0.41	38	93	2
Ilex Group	0.28	40	100	4
Parkstone Group	0.18	36	100	3
Hartford Mutual Funds	0.13	44	100	4
Nuveen Mutual Funds	0.11	137	91	12
Oppenheimer Funds	0.10	145	96	65
Prudential Mutual Funds	0.08	195	94	34
Morgan Stanley Dean Witter Funds	0.08	209	96	69
Bear Stearns	0.07	36	100	1
Fidelity Advisor Funds	0.06	162	99	61
AIM Family of Funds	0.05	158	98	86
Pilgrim Capital Corporation	0.05	64	100	3
Smith Barney Group	0.05	152	98	34
Putnam Funds	0.05	194	100	195
Hancock John Funds	0.05	89	100	23
Heritage Family of Funds	0.05	31	97	1
PIMCO Funds	0.05	141	82	53
Victory Group	0.04	31	97	5
Armada Funds	0.04	44	86	5
Chase Vista Funds	0.03	65	90	10
Safeco Mutual Funds	0.03	44	59	4
Pillar Funds	0.03	31	95	1
Federated Funds	0.03	147	90	32
STI Classic Funds	0.03	62	100	9
Van Kampen Funds	0.02	138	100	46
Merrill Lynch Group	0.02	48	98	71
Dreyfus Premier Funds	0.02	140	98	9
State Street Research Group	0.02	76	96	9
First American Investment Funds	0.01	80	87	12
Lord Abbett Family of Funds	0.01	86	91	21
BlackRock Funds	0.01	133	90	19
Nabors Funds	0.01	197	91	18
Norwest Advantage Funds	0.01	55	90	11
Delaware Investments	0.00	235	98	16
Ark Funds	0.00	34	100	3
ManStay Funds	0.00	166	100	14
Wachovia Funds	0.00	32	86	3
American Express Financial	0.00	103	99	84
One Group	-0.01	128	94	31
Kemper Funds	-0.01	151	99	35
Ivy/Mackenzie Group of Funds	-0.01	60	88	3
Pioneer Group	-0.02	65	100	20
Goldman Sachs Asset Mgmt Group	-0.02	146	89	13
Colonial Group	-0.02	107	99	16
MFS Family of Funds	-0.03	286	97	74
Enterprise Group	-0.03	51	100	3
GE Funds	-0.03	60	82	2
Evergreen Funds	-0.04	184	97	33
Alliance Capital Funds	-0.04	153	97	45
Galaxy Funds	-0.04	46	84	7
Munder Funds	-0.05	102	98	7
Franklin Group of Funds	-0.05	135	99	87
Phoenix Funds	-0.06	119	99	12
Seligman Group	-0.06	67	100	15
Davis Funds	-0.06	36	100	17
Fortis Funds	-0.07	56	100	3
Northstar Funds	-0.08	35	100	3
PaineWebber Mutual Funds	-0.09	68	98	9
Eaton Vance Group	-0.09	145	98	24
Aetna Mutual Funds	-0.10	72	95	2
SEI Funds	-0.10	39	100	18
Mercantile Funds	-0.11	60	96	2
North American Funds	-0.12	38	100	1
First Investors Group	-0.12	38	100	4
Templeton Group	-0.12	36	96	50
New England Fund Group	-0.21	61	91	6
WM Group of Funds	-0.22	33	100	4
AmSouth Funds	-0.22	33	67	2
Stagecoach Funds	-0.24	68	91	6

Notes

1. The standard error for each individual family effect is about 0.205

Figure 1. Trading profits as a function of number of trades



Note: Multiply profit factor by SD(pred), (e.g., 40 basis points for international equity funds) to get trading strategy excess returns.

Abstract

Daily changes in mutual fund net asset values (NAVs) are serially correlated and predicted by prior-day changes in market indices due in part to non-synchronous trading and stale prices being included in NAVs. NAVs are most predictable for international equity funds, whose NAVs almost always use closing prices that are unadjusted for movements in the U.S. market since foreign markets closed. Investors trading on this predictability in international equity, U.S. small-cap equity, and high-yield bond funds can earn excess returns of 9-12 percent, 6-8 percent, and 2-4 percent, respectively, while making only four roundtrip trades per year. This trading frequency is allowed without transaction fees by about half of no-load international equity funds. The pricing of exchange-traded closed-end funds and ADRs also does not fully reflect predictable changes in closed-end fund NAVs or foreign market indices, although transaction costs prevent an arbitrage strategy. The potential for profitable trading of open-end funds poses a threat to the returns of buy-and-hold investors and may require changes in mutual-fund or even regulatory policies.